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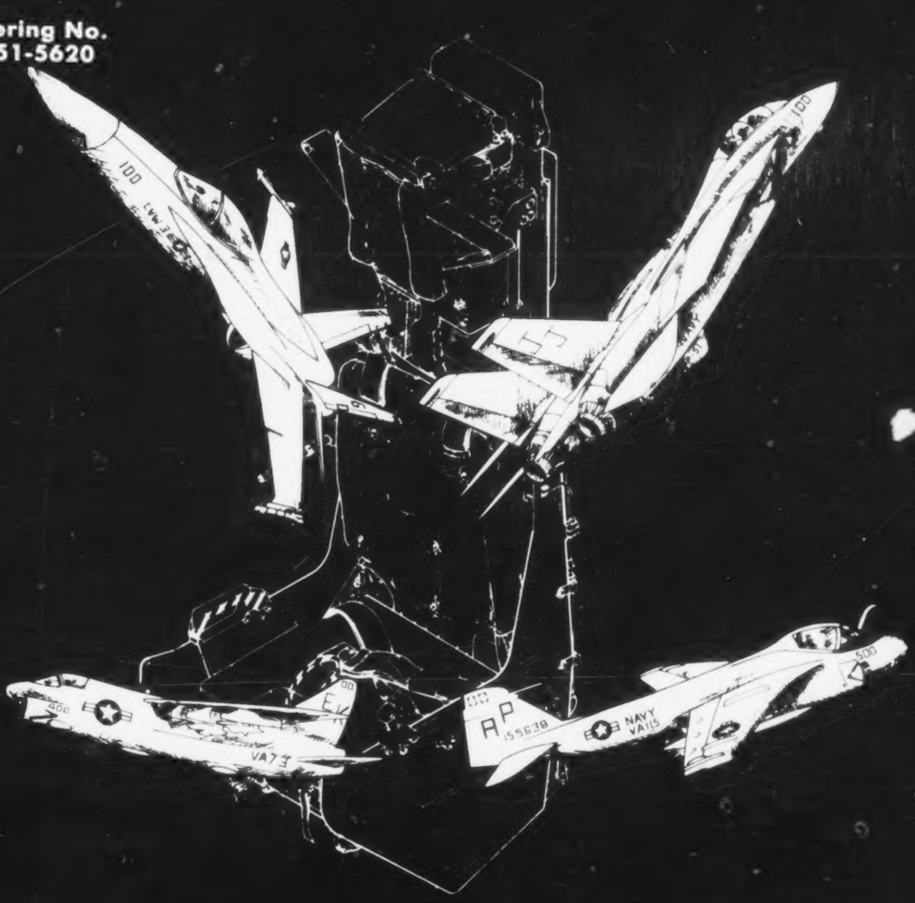
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AVIATION
STRUCTURAL MECHANIC E 1 & C

NAVAL EDUCATION AND TRAINING COMMAND

RATE TRAINING MANUAL AND NONRESIDENT CAREER COURSE

NAVEDTRA 10312-D

AVIATION STRUCTURAL MECHANIC E 1 & C RTM & NRCC

NAVEDTRA 10312-D

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UTION STATEMENT A

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Naval Education And Training Program Development Center

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NAVEDTRA 10312-D

DEPARTMENT OF THE NAVY
CHIEF OF NAVAL EDUC AND TNG

1985 Edition Prepared by
AMEC Arthur R. Paulsen, AMEC Glenn Dewsnap,
and AMEC James E. Jenks

PREFACE

This Rate Training Manual and Nonresident Career Course (RTM/NRCC) form a self-study package that will enable the enrollees to gain information which will help them fulfill the requirements of their rating.

Designed for individual study and not formal classroom instruction, the RTM provides subject matter that relates directly to the occupational qualifications of the Aviation Structural Mechanic E rating. The NRCC provides the usual way of satisfying the requirements for completing the RTM. The set of assignments in the NRCC includes learning objectives and supporting items designed to emphasize the key point covered in the RTM.

This training manual and nonresident career course was prepared by the Naval Education and Training Program Development Center, Pensacola, Florida, for the Chief of Naval Education and Training. Technical assistance was provided by the Naval Air Technical Training Center, Millington, TN, U.S. Naval Safety Center, Norfolk, VA, Naval Air Maintenance Training Detachment, Cecil Field, Jacksonville, FL, and the Naval Aviation Logistics Center, Patuxent River, MD.

Revised 1985

Stock Ordering No.
0502-LP-051-5620

Published by
NAVAL EDUCATION AND TRAINING PROGRAM
DEVELOPMENT CENTER

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON, D.C.: 1985

THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

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38 ADMINISTRATION		
38929	MAINTAIN SHOP LOGS AND RECORDS	1
38995	ORGANIZE AND MAINTAIN VISUAL INFORMATION DISPLAY SYSTEM	AMR 1 & C
44 TRAINING		
44471	INSTRUCT PERSONNEL ON MAINTENANCE OF ENVIRONMENTAL, UTILITY AND EGRESS SYSTEMS	2,3,4,5
46 PUBLICATIONS		
46026	MAINTAIN TECHNICAL PUBLICATIONS, DIRECTIVES AND MANUALS	AMR 1 & C
50 MAINTENANCE PLANNING AND QUALITY ASSURANCE		
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50978	REVIEW COMPLETED MAINTENANCE DATA SYSTEM (MDS) FORMS	AMR 1 & C
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CHIEF AVIATION STRUCTURAL MECHANIC (SAFETY EQUIPMENT) (AMEC)

38 ADMINISTRATION		
38324	PREPARE DRAFTS OF MAINTENANCE INSTRUCTIONS	AMR 1 & C
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CHAPTER 1

EMERGENCY EGRESS AND CANOPY SYSTEMS

The *Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards*, NAVPERS 18068 (Series), states that the AME is responsible for the maintenance of many systems. Some of these systems are covered in this manual. Other areas that the AME1 and AMEC must be qualified in are maintaining work center records, preparing reports, and training and leadership. The training and leadership responsibilities are addressed in the *Aviation Maintenance Ratings 1 & C*, NAVEDTRA 10343 (Series), which is to be completed along with this rate training manual (RTM).

ELECTRICALLY OPERATED CANOPY SYSTEM

The canopy system provides an access for the aviator to enter and exit the cockpit. It also provides protection from the elements. The F/A-18A canopy system is used in this chapter to discuss a typical electrically operated system. (See figure 1-1.)

Under normal conditions, the canopy is electrically operated and controlled by either the internal canopy control switch in the cockpit or the external canopy control switch. (See figures 1-2 and 1-3.) A manual back-up control mode is provided for canopy operation when utility battery power is low, internal or external electrical power is not available, or the actuation control system has failed. The emergency canopy jettison system is provided to jettison the canopy during emergencies and ejection.

SYSTEM COMPONENTS

Familiarity with the system components is needed to enhance the understanding of the system's operations. Therefore, eight major and several miscellaneous components are described in this chapter.

Canopy

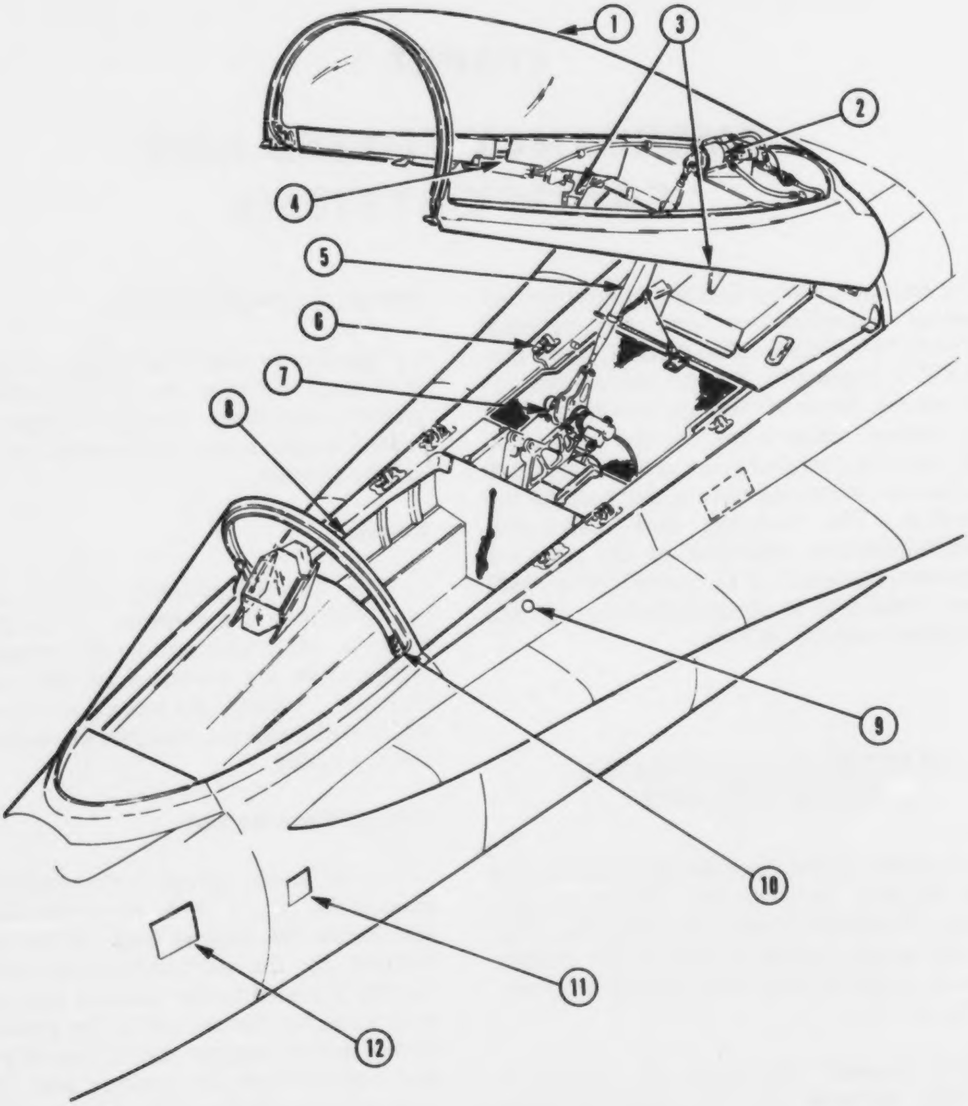
The formed-stretched acrylic canopy is mounted in a metal frame. A canopy unlatch thruster, two rocket motors and related ballistic components are mounted on the canopy for emergency jettison. An index pin, a control cam, and three latches are mounted on each side of the canopy frame.

Canopy Pressure Seal

An inflatable canopy pressure seal is located around the canopy arch, along the side frames, and across the canopy deck. When the seal is inflated by the air-conditioning system, the canopy is sealed to the fuselage and windshield arch allowing the cockpit to be pressurized. A noninflatable weather seal is located parallel to and outboard of the pressure seal. When the pressure seal is deflated, the weather seal prevents entry of water into the cockpit.

Canopy Actuator

The canopy actuator is located behind the aircraft ejection seat on the canopy deck and functions to open and close the canopy. A thermal protection device is provided in the actuator that will automatically interrupt power to the actuator when an overheat condition exists. It will



1. Canopy
2. Canopy unlatch thruster
3. Canopy control cams
4. Canopy jettison rocket motor
5. Canopy actuation link
6. Canopy latch retainer
7. Canopy actuator
8. Internal canopy control switch
9. Canopy external manual drive receptacle
10. Internal canopy jettison handle
11. External canopy control switch
12. External canopy jettison handle

214.167

Figure 1-1.—Electrically operated canopy.

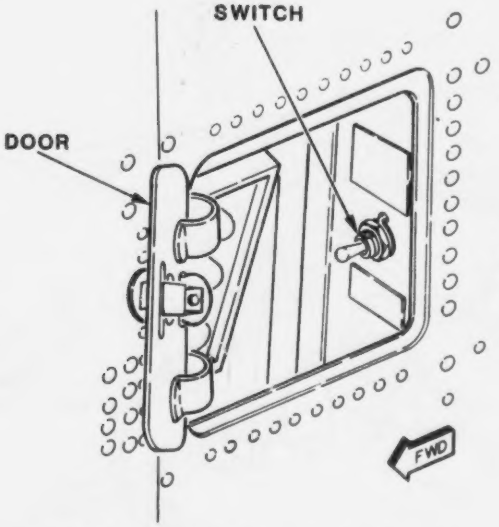


Figure 1-2.—External canopy control switch.

automatically reset within 60 seconds after removal of the overheat condition.

The mechanical components of the canopy actuation system consist of the canopy actuator and the canopy actuation connecting link, which is attached to the canopy unlatch thruster. (See figures 1-4 and 1-5.)

Canopy Actuator Manual Drive Unit

The canopy actuator manual drive unit is located in the cockpit under the left canopy sill. It is used to manually raise and lower the canopy.

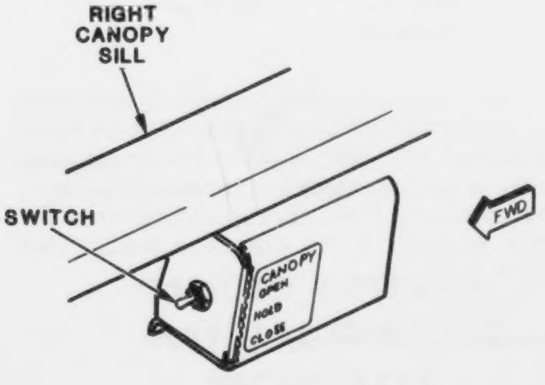
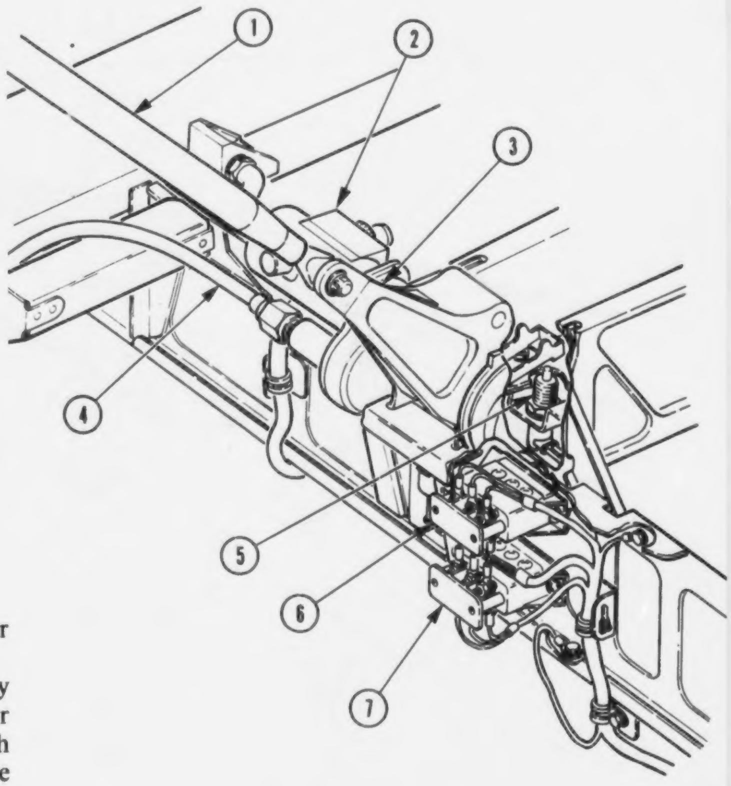


Figure 1-3.—Internal canopy control switch.

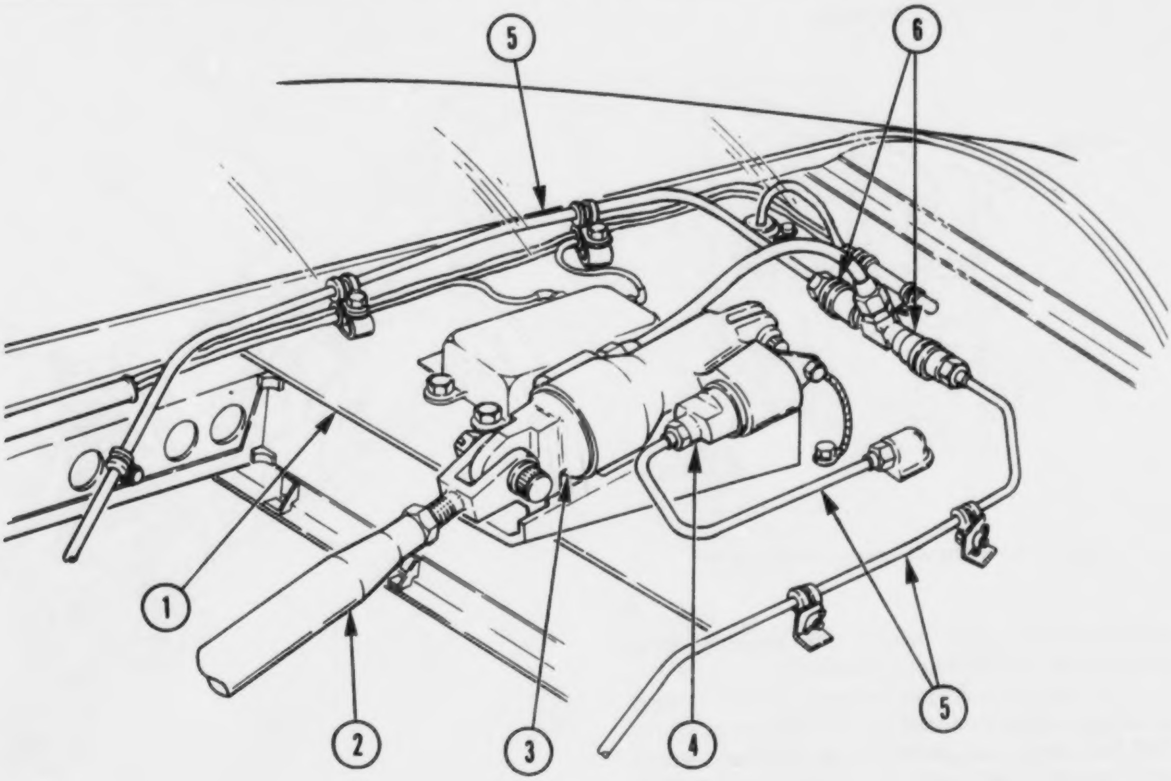


1. **Connecting link**
2. **Actuator**
3. **Actuator arm**
4. **Manual opening shaft assembly**
5. **Canopy locked switch**
6. **Canopy down contactor**
7. **Canopy up contactor**

214.168

Figure 1-4.—Canopy actuator.

The internal manual canopy opening handle is located on the canopy actuator manual drive unit. The handle is used to operate the drive unit from inside the cockpit. The opening handle shaft assembly is located between the canopy actuator manual drive unit and the canopy actuator. The shaft assembly provides a mechanical



1. Canopy deck
2. Actuation connecting link
3. Canopy unlatch thruster
4. Canopy unlatch thruster cartridge
5. SMDC
6. Canopy jettison rocket motor initiator

214.169

Figure 1-5.—Canopy unlatch thruster.

link between the drive unit and the canopy actuator. (See figure 1-6.)

The canopy external manual drive receptacle is mounted flush with the fuselage skin below the left canopy sill. The drive receptacle is used to operate the drive unit from outside the cockpit with the aid of a 3/8-inch drive tool. (See figure 1-7.)

Canopy Control Switches

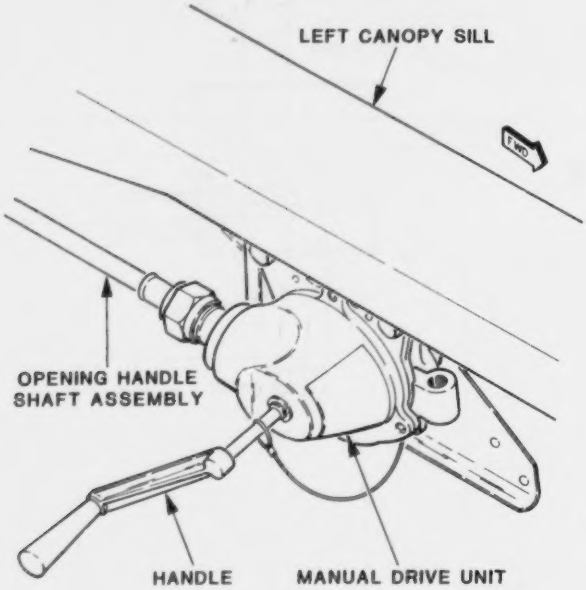
Two canopy control switches are provided for normal electrical operation of the canopy. The external canopy control switch is located inside the external electrical power receptacle door. (See figure 1-2.) The internal canopy control switch is located in the cockpit under the right canopy sill.

Canopy Contactors

The two contactors for canopy up and down are located on the forward bulkhead of the upper equipment bay. The down contactor supplies power to the close winding of the canopy actuator. The canopy up contactor supplies power to the open winding of the canopy actuator. (See figure 1-4.)

Canopy Locked Switch

The canopy locked switch is located in the upper equipment bay under the canopy actuator. (See figure 1-4.) When the switch plunger is


LEFT CANOPY SILL
FWD
OPENING HANDLE SHAFT ASSEMBLY
HANDLE
MANUAL DRIVE UNIT

214.170

Figure 1-6.—Canopy actuator manual drive unit and handle.

depressed by the actuator arm, an electrical signal is supplied to extinguish the canopy warning light. The switch also interups power to the actuator.

Canopy Position Switch

The canopy position switch is mounted on the right canopy sill in the number 4 canopy latch retainer. When the plunger switch is depressed by the number 4 right canopy latch, an electrical signal is supplied to extinguish the canopy warning light. (See figure 1-8.)

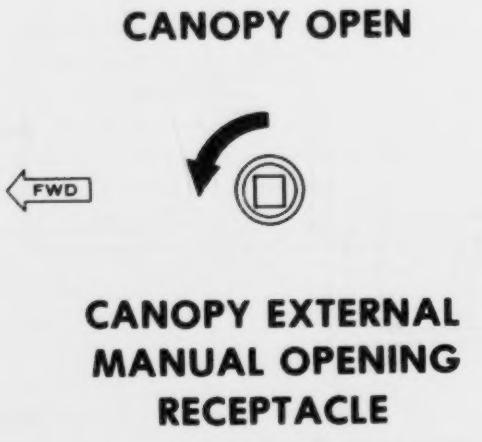

CANOPY OPEN
FWD
CANOPY EXTERNAL MANUAL OPENING RECEPTACLE

Figure 1-7.—Canopy external manual drive receptacle.

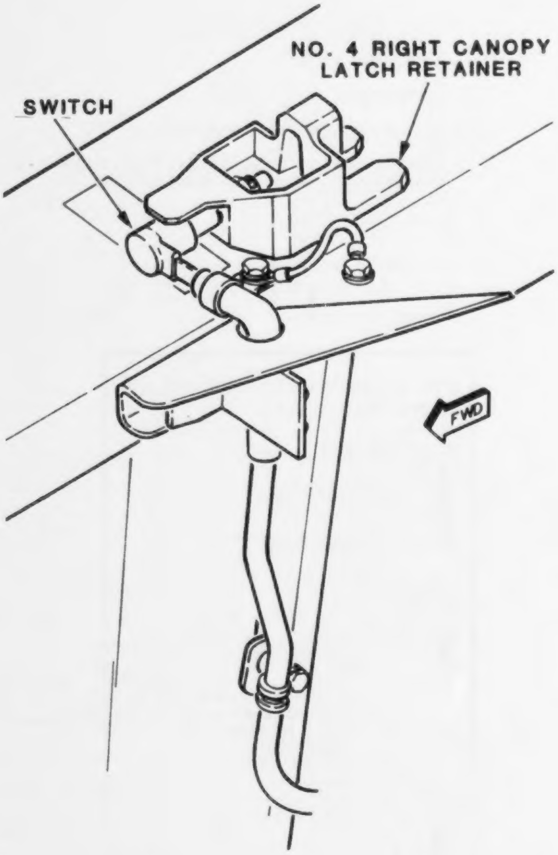
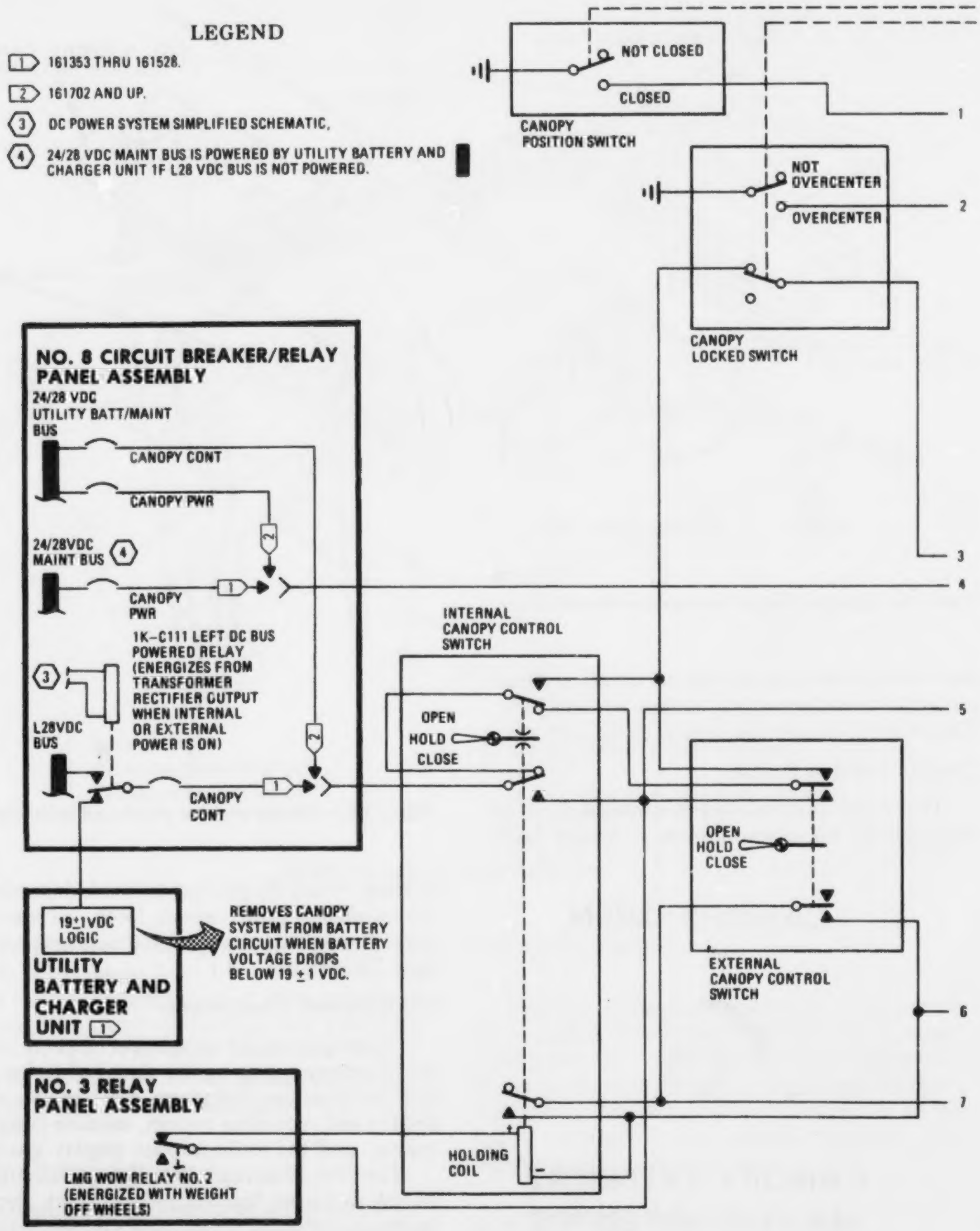

SWITCH
NO. 4 RIGHT CANOPY LATCH RETAINER
FWD

Figure 1-8.—Canopy position switch and latch retainer.

Miscellaneous Components

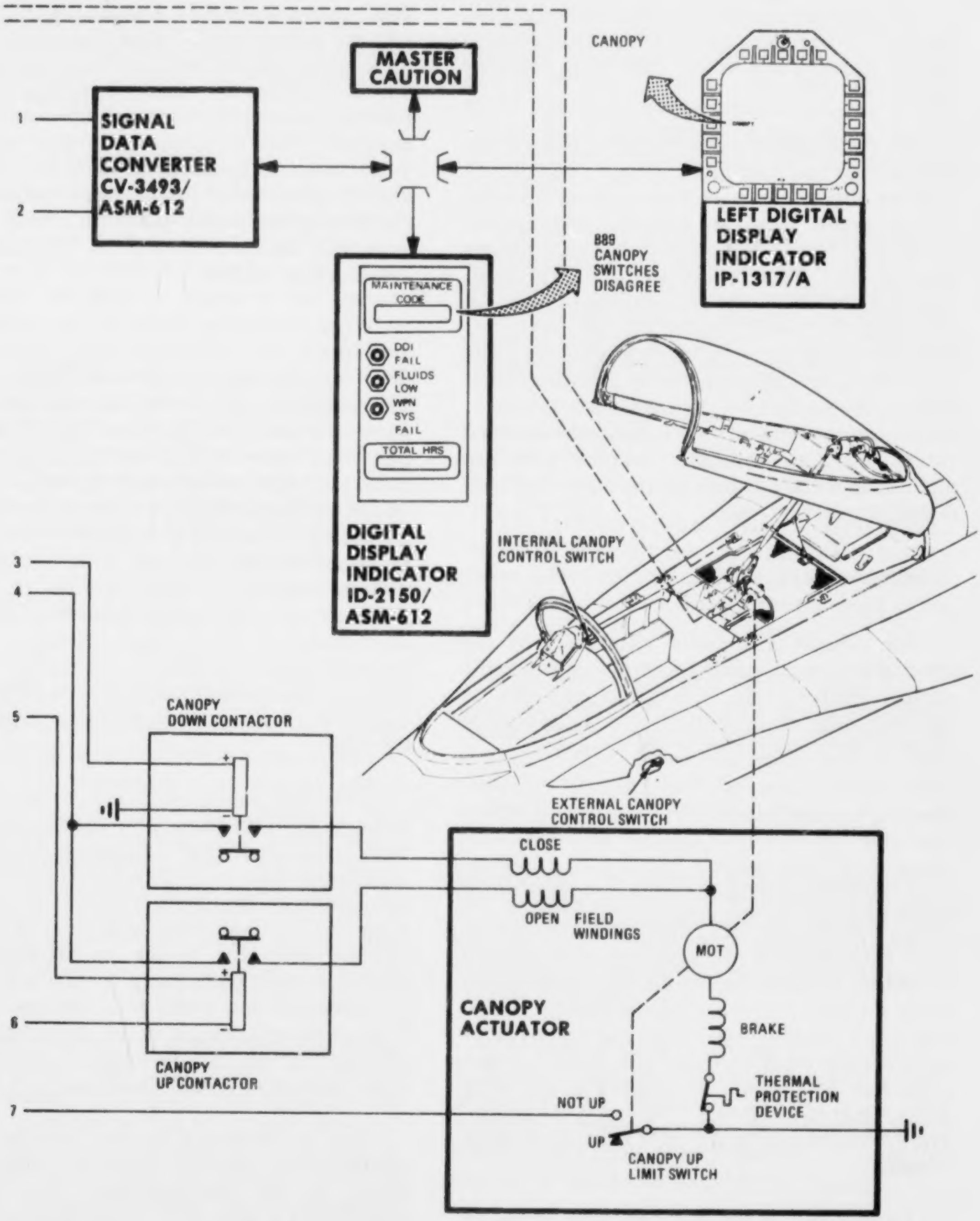
Other systems and components that are related to the canopy system are the electrical system, air-cycle air-conditioning system, maintenance status display and recording system, mission computer system, and the multipurpose display group.

The F/A-18 aircraft electrical system supplies 28-volt dc power for canopy operation. Because the bus distribution system varies depending upon the bureau number of the aircraft, reference should be made to the maintenance instruction manuals to determine the applicable configuration. (See electrical schematic figure 1-9.)


LEGEND
1 161353 THRU 161528.
2 161702 AND UP.
3 DC POWER SYSTEM SIMPLIFIED SCHEMATIC.
4 24/28 VDC MAINT BUS IS POWERED BY UTILITY BATTERY AND CHARGER UNIT 1F L28 VDC BUS IS NOT POWERED.
NOT CLOSED
CLOSED
CANOPY POSITION SWITCH
NOT OVERCENTER
OVERCENTER
CANOPY LOCKED SWITCH
1
2
3
4
5
6
7
NO. 8 CIRCUIT BREAKER/RELAY PANEL ASSEMBLY
24/28 VDC UTILITY BATT/MAINT BUS
CANOPY CONT
CANOPY PWR
24/28VDC MAINT BUS 4
CANOPY PWR
1K-C111 LEFT DC BUS POWERED RELAY (ENERGIZES FROM TRANSFORMER RECTIFIER OUTPUT WHEN INTERNAL OR EXTERNAL POWER IS ON)
L28VDC BUS
CANOPY CONT
INTERNAL CANOPY CONTROL SWITCH
OPEN
HOLD
CLOSE
OPEN
HOLD
CLOSE
EXTERNAL CANOPY CONTROL SWITCH
19±1VDC LOGIC
UTILITY BATTERY AND CHARGER UNIT 1
REMOVES CANOPY SYSTEM FROM BATTERY CIRCUIT WHEN BATTERY VOLTAGE DROPS BELOW 19 ± 1 VDC.
NO. 3 RELAY PANEL ASSEMBLY
LMG WOW RELAY NO. 2 (ENERGIZED WITH WEIGHT OFF WHEELS)
HOLDING COIL
+
−

214.171

Figure 1-9.—Canopy electrical system schematic.


CANOPY
MASTER CAUTION
1
SIGNAL DATA CONVERTER CV-3493/ ASM-612
2
LEFT DIGITAL DISPLAY INDICATOR IP-1317/A
889 CANOPY SWITCHES DISAGREE
MAINTENANCE CODE
DDI FAIL
FLUIDS LOW
WPN SYS FAIL
TOTAL HRS
DIGITAL DISPLAY INDICATOR ID-2150/ ASM-612
INTERNAL CANOPY CONTROL SWITCH
3
4
5
CANOPY DOWN CONTACTOR
EXTERNAL CANOPY CONTROL SWITCH
CLOSE
OPEN
FIELD WINDINGS
MOT
CANOPY ACTUATOR
BRAKE
6
CANOPY UP CONTACTOR
THERMAL PROTECTION DEVICE
7
NOT UP
UP
CANOPY UP LIMIT SWITCH

214.171

Figure 1-9.—Canopy electrical system schematic—Continued.

The air-cycle air-conditioning system supplies partially cooled bleed air for the inflation of the canopy pressure seal to maintain cabin pressurization.

The maintenance status display and recording system, mission computer system, and multipurpose display group all receive inputs from the canopy system. Inputs are processed and supplied to the left digital display indicator and master caution light. The inputs are also processed, recorded, and displayed as maintenance codes on the nosewheel well digital display indicator. Canopy caution and warning indicators are made up of the following components: canopy caution light on the cockpit left digital display indicator, master caution light on the left-hand advisory and threat warning indicator panel, and the maintenance code display on the nosewheel well digital display indicator.

NORMAL OPERATION

The canopy is operated electrically by the external or internal canopy control switches in the normal control mode. The canopy can also be operated manually in the back-up manual control mode if electrical power is not available.

Normal Control Mode

The canopy may be operated with the external canopy control switch. To open the canopy, the switch is held in the OPEN position. The canopy stops automatically when the full open position is reached. To close the canopy, the switch is held in the CLOSE position until the canopy closes, moves full forward, and locks. The canopy stops automatically when the closed and locked position is reached. Motion may be stopped at any point during opening or closing by releasing the switch. The switch returns to the HOLD position when released.

To open the canopy internally with weight on the wheels, the internal canopy control switch is set to OPEN and released. The switch is magnetically held in the OPEN position until the canopy raises to full open and stops. The switch then returns to HOLD. Canopy motion may be stopped at any point during canopy opening by manually setting the switch to the HOLD position, which overrides the magnetic holding coil. The internal canopy control switch opening circuit is equipped with a weight-off-wheels relay that deenergizes the magnetic holding coil when the aircraft is in a weight-off-wheels condition. With the holding coil deenergized, the switch must be manually held to the OPEN position when opening the canopy.

When the canopy closes, moves full forward, and locks, the number 4 right canopy latch depresses the canopy position switch plunger. Simultaneously, the canopy actuator arm rotates overcenter and depresses the canopy locked switch plunger. Depressing both switch plungers causes the master caution light and the canopy display on the left digital display indicator to extinguish, indicating the canopy is fully closed and locked. If both switches are not fully depressed or a failure occurs in either switch, the master caution and canopy caution indicators will remain illuminated. If both switch plungers are not depressed within 15 seconds, the canopy switches disagree and the maintenance code (889) will be displayed on the nosewheel well digital display indicator.

Electrical inputs supplied to the canopy actuator are transformed into mechanical motion used to raise and lower the canopy. The actuator is equipped with an up-travel-limit switch, which automatically interrupts power to the actuator when the full open position is reached. With no aircraft generator power or external power applied, a utility battery supplies power for at least five open and close cycles of the canopy. On some F/A-18 aircraft, a logic circuit in the battery and charger unit secures the canopy control power when the battery voltage drops below 19 ± 1 volts.

Due to decreased battery capacity at low temperatures, canopy operation using battery power is not recommended when ambient temperature is below 0°F. Under these conditions, external electrical power should be used. When external power is not available, the canopy can be operated using the back-up manual control mode.

To further understand how the opening and closing cycles function, refer to the canopy electrical schematic, figure 1-9, while reading the following paragraphs.

CANOPY OPENING.—Setting the external or internal canopy control switch to OPEN switches 24-volt dc utility battery power or 28-volt dc aircraft power to the canopy up contactor coil. Energizing the up contactor supplies power to the open field winding to energize the canopy actuator.

With weight on the wheels, setting the internal canopy control switch to the open position also energizes the internal control switch holding coil through the left main gear weight-on-wheels relay number 2. The coil magnetically holds the switch to OPEN. The canopy up limit switch in the actuator opens the ground circuit of the coil when the actuator reaches the full up position. When the holding coil ground circuit is opened, the deenergized coil allows the switch to return to HOLD.

CANOPY CLOSING.—Setting the external or internal canopy control switch to CLOSE supplies 24-volt dc utility battery power or 28-volt dc aircraft power through the canopy locked switch to the canopy down contactor coil. Energizing the down contactor coil supplies power to the close field winding, energizing the canopy actuator. Energizing the actuator disengages the mechanical brake and causes the actuator motor to rotate the actuator arm. As the actuator arm rotates, the canopy is lowered toward the closed position.

Canopy downward motion is controlled by the canopy control cams and rollers. When the canopy reaches full down, the acutator arm continues to rotate, pulling the canopy forward. As the canopy moves forward, the index pins on the canopy arch align the canopy with the windshield arch and the canopy latches engage the latch retainers, providing vertical restraint. The number 4 right canopy latch depresses the canopy position switch plunger which supplies ground to the signal data converter. When the canopy has reached full forward, the actuator arm continues to rotate the connecting link to an overcenter position. The actuator arm depresses the canopy locked switch plunger. This deenergizes the down contactor and interrupts canopy power to the actuator. Depressing the locked switch plunger also supplies ground to the signal data converter.

Canopy longitudinal restraint is provided by the connecting link being rotated overcenter by the actuator arm. The canopy actuator mechanical brake, engaged when the actuator is deenergized, provides a secondary positive lock to hold the actuator in the overcenter position.

Back-up Manual Control Mode

The back-up manual control mode is used to open and close the canopy when utility battery power is low, internal or external electrical power is not available, or a failure has occurred in the canopy actuation control system.

The canopy actuator manual drive unit is operated from inside the cockpit using the internal manual canopy opening handle. The handle is removed from its stowage receptacle and clip, and then it is inserted into the crank socket. The handle is turned 70 ± 1 turns clockwise to close the canopy or counterclockwise to open the canopy. The internal manual canopy opening handle shaft assembly mechanically links the drive unit to the canopy actuator. By operating the drive unit internally or externally, mechanical motion is transferred through the shaft assembly to the canopy actuator.

The canopy external manual drive receptacle is provided to operate the canopy actuator manual drive unit from outside the cockpit. A 3/8-inch drive tool is inserted into the drive receptacle and turned 35 ± 1 turns counterclockwise to open the canopy or clockwise to close the canopy.

Manually operating the canopy overrides the mechanical brake in the canopy actuator. The brake engages to hold the canopy at any position when manual cranking is stopped. The actuator is equipped with a mechanical torque limiter which prevents damage to the actuator if excessive torque is applied to the manual back-up control mode.

EMERGENCY CANOPY JETTISON SYSTEM

The emergency canopy jettison system provides the capability to ballistically jettison the canopy in case of an emergency. The canopy can be jettisoned internally or externally without initiating seat ejection. It can also be jettisoned by initiating ejection. This is accomplished by pulling the ejection control handle on the ejection seat.

Emergency Canopy Jettison System Components

Before discussing the internal and external methods of jettisoning the canopy, a description of the system's components is needed.

EXTERNAL CANOPY JETTISON HANDLES AND CABLES.—The external canopy jettison handles and cables are stowed behind doors on each side of the aircraft near the radome. (See figures 1-1 and 1-10.) Each handle is attached to approximately 8 feet of cable. The cables are routed through the gun bay and are joined to a common cable at the cockpit forward pressure bulkhead. This single common cable runs through the bulkhead into the cockpit where it connects to the internal canopy jettison lever linkage.

INTERNAL CANOPY JETTISON LEVER.—The internal canopy jettison lever is located to the left of the main instrument panel. The lever is mounted on the canopy sill. (See figure 1-11.) The lever provides the pilot with the capability of starting the emergency canopy jettison sequence from inside the cockpit.

CANOPY JETTISON SMDC INITIATOR.—The canopy jettison shielded mild detonating cord (SMDC) initiator is located below the canopy jettison lever. The initiator receives inputs from either the internal canopy jettison lever or external canopy jettison handles to initiate the jettison sequence.

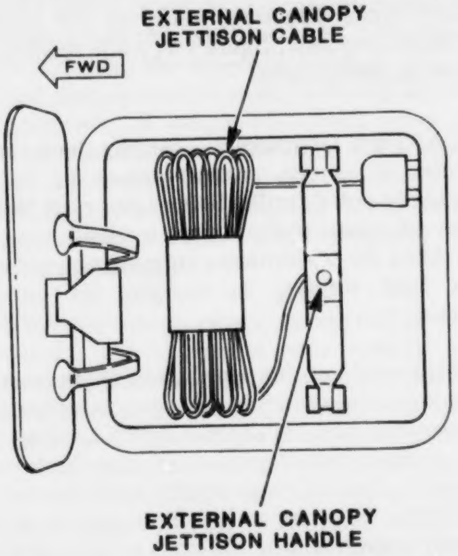

EXTERNAL CANOPY JETTISON CABLE
FWD
EXTERNAL CANOPY JETTISON HANDLE

Figure 1-10.—External canopy jettison handle.

ONE-WAY TRANSFER VALVE.—The one-way transfer valve is located on the ballistic panel in the upper equipment bay. The transfer valve acts as a check valve to prevent the backflow of SMDC detonation to the seat components.

EMERGENCY ESCAPE DISCONNECT.—The emergency escape disconnect is located under the canopy deck. The disconnect provides a path for SMDC detonation to the canopy ballistic components and provides a disconnect point when the canopy is jettisoned or removed for maintenance.

CANOPY UNLATCH THRUSTER AND CARTRIDGE.—The cartridge is mounted in the canopy unlatch thruster. (See figure 1-5.) Pressure from the canopy jettison SMDC initiator fires the thruster mounted on the canopy deck. When fired, it moves the canopy aft to disengage the latches and

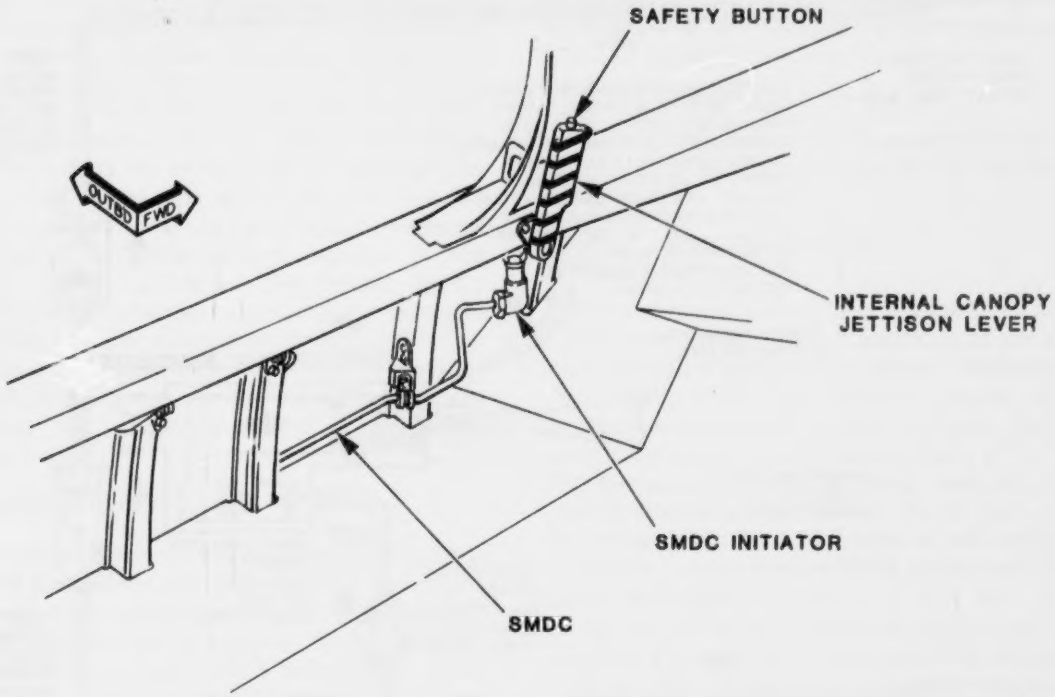


Figure 1-11.—Internal canopy jettison handle.

to separate the canopy from the actuation connecting link. Thruster ballistic gas is provided to the canopy jettison rocket motor initiators.

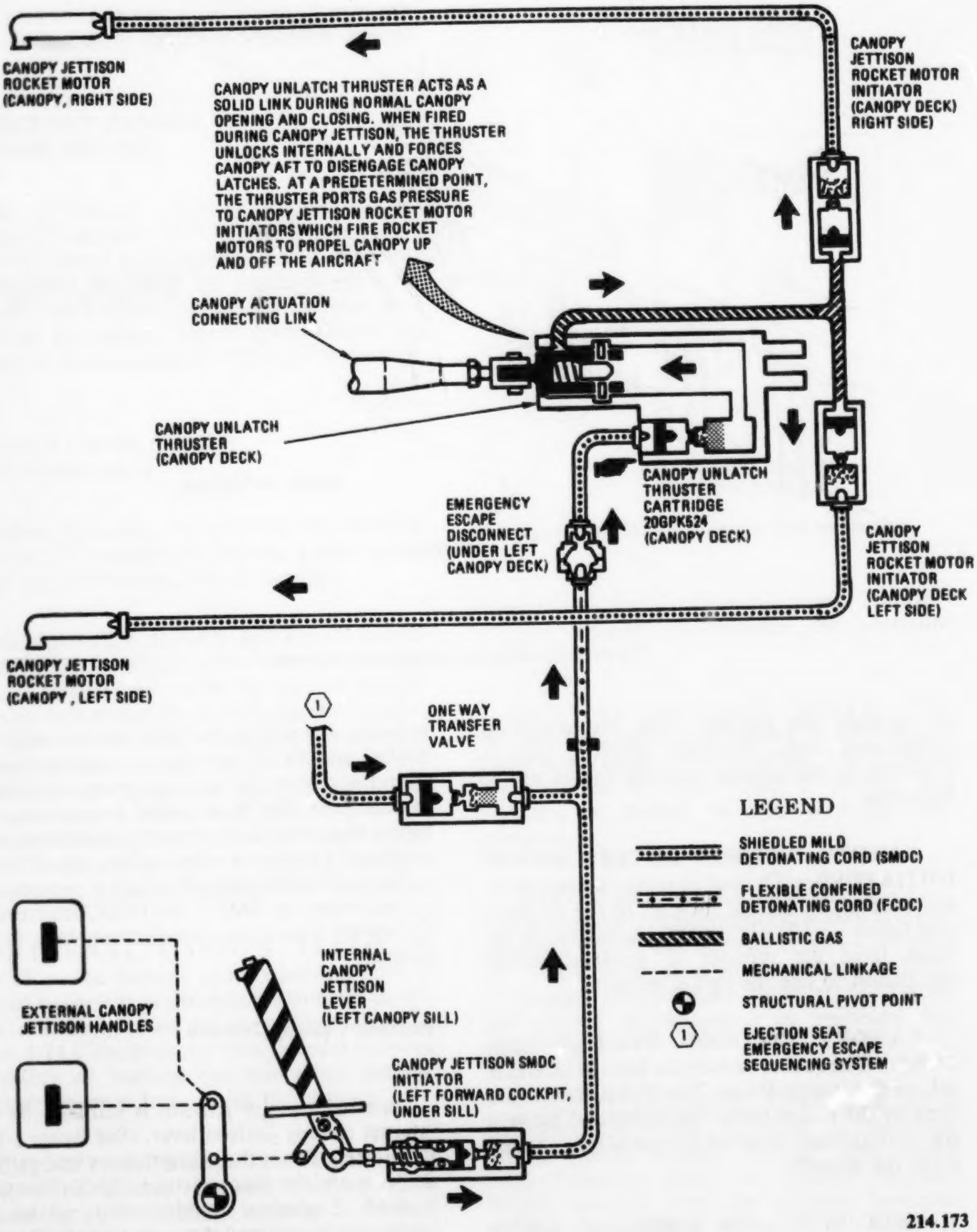
CANOPY JETTISON ROCKET MOTOR INITIATORS.—The rocket motor initiators are mounted on the canopy deck aft of the thruster. (See figure 1-5.) The initiators receive ballistic gas input from the thruster to produce SMDC detonation to fire the rocket motors.

CANOPY JETTISON ROCKET MOTORS.—The rocket motors are located on either side of the canopy frame. The rocket motors are fired by the rocket motor initiators and provide the vertical thrust required to separate the canopy from the aircraft.

SMDC/FCDC.—The SMDC and flexible confined detonating cord (FCDC) are located between the various ballistic components. The SMDC and FCDC provide the energy transfer stimulus used in the emergency canopy jettison system. The SMDC is sealed in stainless steel tubing to protect the cord and to contain all gases produced by explosive detonation. The FCDC is sealed in a metallic sheath, which is protected by a braid overwrap. SMDC and FCDC maintenance and safety precautions are discussed later in this chapter.

Internal Canopy Jettison

Internal canopy jettison is initiated by the internal canopy jettison lever. (See figure 1-11.) By pressing down the safety button and pulling the lever aft, the canopy jettison SMDC initiator is fired. Explosive stimulus produced by the initiator is transferred through the SMDC to the emergency escape disconnect. The one-way


CANOPY JETTISON ROCKET MOTOR (CANOPY, RIGHT SIDE)
CANOPY JETTISON ROCKET MOTOR INITIATOR (CANOPY DECK) RIGHT SIDE)
CANOPY UNLATCH THRUSTER ACTS AS A SOLID LINK DURING NORMAL CANOPY OPENING AND CLOSING. WHEN FIRED DURING CANOPY JETTISON, THE THRUSTER UNLOCKS INTERNALLY AND FORCES CANOPY AFT TO DISENGAGE CANOPY LATCHES. AT A PREDETERMINED POINT, THE THRUSTER PORTS GAS PRESSURE TO CANOPY JETTISON ROCKET MOTOR INITIATORS WHICH FIRE ROCKET MOTORS TO PROPEL CANOPY UP AND OFF THE AIRCRAFT
CANOPY ACTUATION CONNECTING LINK
CANOPY UNLATCH THRUSTER (CANOPY DECK)
CANOPY UNLATCH THRUSTER CARTRIDGE 20GPK524 (CANOPY DECK)
EMERGENCY ESCAPE DISCONNECT (UNDER LEFT CANOPY DECK)
CANOPY JETTISON ROCKET MOTOR INITIATOR (CANOPY DECK LEFT SIDE)
CANOPY JETTISON ROCKET MOTOR (CANOPY , LEFT SIDE)
1
ONE WAY TRANSFER VALVE
LEGEND
SHIEDLED MILD DETONATING CORD (SMDC)
FLEXIBLE CONFINED DETONATING CORD (FCDC)
BALLISTIC GAS
MECHANICAL LINKAGE
STRUCTURAL PIVOT POINT
1
EJECTION SEAT EMERGENCY ESCAPE SEQUENCING SYSTEM
EXTERNAL CANOPY JETTISON HANDLES
INTERNAL CANOPY JETTISON LEVER (LEFT CANOPY SILL)
CANOPY JETTISON SMDC INITIATOR (LEFT FORWARD COCKPIT, UNDER SILL)

214.173

Figure 1-12.—Canopy jettison system schematic.

transfer valve prevents the explosive stimulus from continuing toward the ejection seat components. The explosive stimulus continues through the emergency escape disconnect, via the FCDC, to the canopy unlatch thruster cartridge, which fires the canopy unlatch thruster. Firing the unlatch thruster pushes the canopy aft to disengage the canopy latches and separates the thruster from the connecting link. Ballistic gas produced by firing the thruster is transferred to the canopy jettison rocket motor initiators. The rocket motor initiators convert ballistic-gas pressure to explosive stimulus, which is transferred through SMDC to fire the canopy jettison rocket motors. The rocket motors produce the vertical thrust required to separate the canopy from the aircraft. (See figure 1-12.)

External Canopy Jettison

Ground emergency external canopy jettison is started by opening the door on either the left or right side of the aircraft and removing the canopy jettison handle from its retaining clip. The handle is attached to approximately 8 feet of cable. When the cable is fully extended and pulled, the canopy jettison SMDC initiator is fired which, in turn, initiates the emergency canopy jettison sequence. From this point on, the sequence is the same as internal canopy jettison. The cable action merely bypasses the internal canopy jettison lever. When the canopy is jettisoned, all canopy jettison ballistic devices are spent.

FRANGIBLE ESCAPE SYSTEMS

A frangible escape system is an explosively operated system that cuts an exit through the canopy directly over the head of each occupant. The S-3A canopy removal system employs SMDC in lieu of hot gas and flexible linear shaped charge (FLSC) in lieu of actuators found in other hot gas explosive systems.

Normal entry and exit of the S-3A aircraft is through the entrance hatch vice a canopy as in other ejection seat type of aircraft. So, the canopy system is used primarily for ground and water rescue. Normal seat ejection is through the canopy glass for the front seats and through the hatch glass for the rear seats. In both cases, exit is made without benefit of having the glass removed or cut as the seats are equipped with glass crashers. Breaker plates are installed on each canopy and hatch to assist the seat during ejection.

SYSTEM COMPONENTS

A brief description of the emergency egress system components is contained in the following paragraphs.

External Canopy and Hatch Jettison Initiator

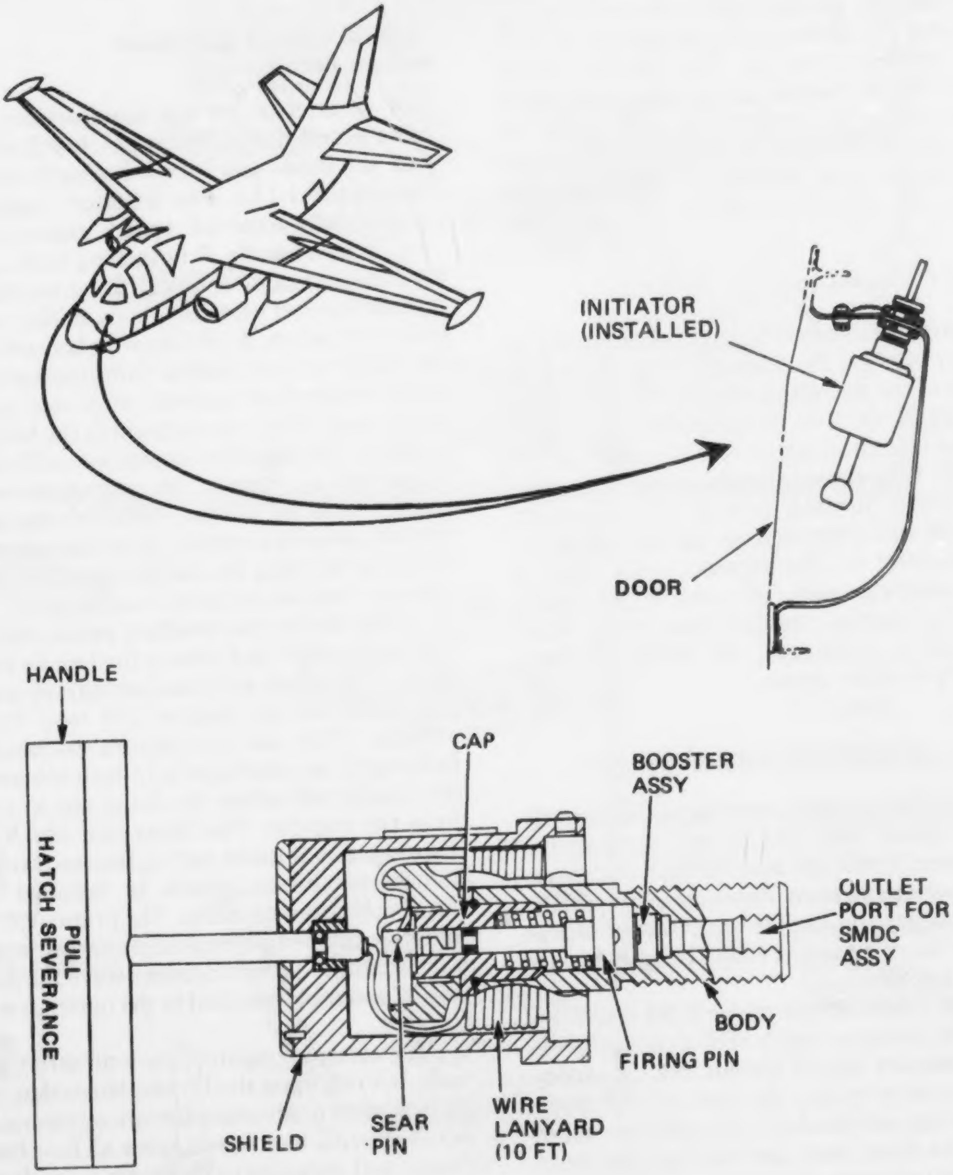
Two external jettison initiators are installed inside access doors, one on each side of the aircraft just below and forward of each windshield. (See figure 1-13.) The initiator consists of a mechanically-actuated sealed explosive device containing a handle, four locking balls, a 10-foot wire lanyard, a mechanical firing mechanism, a transfer booster assembly, body shield, and a ball lock mechanism. A 10-foot wire lanyard attaches the handle to a mechanical firing mechanism. The firing mechanism consists of a sear pin, cap, spring, and firing pin enclosed in the body of the initiator. The transfer booster assembly contains a percussion primer, an initiation explosive charge, and an output explosive charge. The transfer booster assembly produces a detonation wave that initiates the SMDC assembly, which is screwed into the initiator's outlet port.

When the initiator handle is pulled, the locking balls will retract and release the handle from the shield. The handle and attached lanyard are pulled the length of the lanyard (10 feet) from the initiator. With the wire lanyard extended to its full length, an additional 0.75-inch movement of the handle will allow the firing pin to separate from the sear pin. The firing pin, which is now disengaged and under spring tension, strikes the percussion primer, which is installed in the transfer booster assembly. The primer ignites the initiation and output explosive charges producing a detonation. The detonation wave initiates the SMDC assembly installed in the outlet port of the initiator.

The external initiators have no safety pins as such, but rely upon the 10-foot lanyard to protect them against inadvertent initiation. Operation of either external handle will cause all four hatches, fillets, and supports to be blown away from the aircraft. Partial withdrawal of any handle is cause for rejection and replacement.

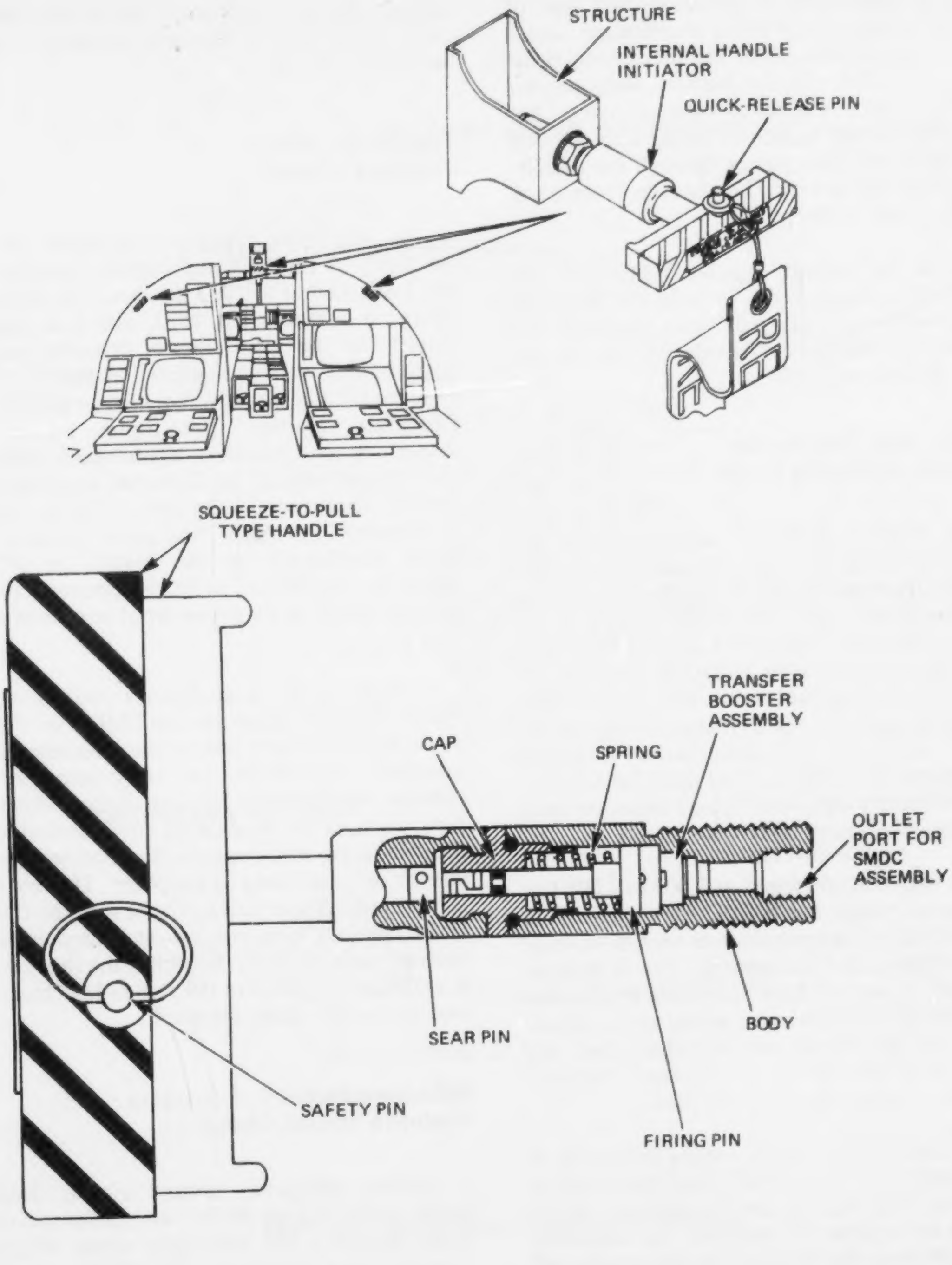
Internal Canopy and Hatch Jettison Initiator

The internal initiator is used to actuate the canopy and hatch system without activating the ejection seat system. Three internal initiators are located in the S-3A aircraft crew compartment. One initiator is located in the overhead between the pilot and copilot. Initiators are also located at both the TACCO and SENSO positions on the outboard side of each instrument panel. (See figure 1-14.)


INITIATOR (INSTALLED)
DOOR
HANDLE
PULL HATCH SEVERANCE
CAP
BOOSTER ASSY
OUTLET PORT FOR SMDC ASSY
BODY
FIRING PIN
WIRE LANYARD (10 FT)
SEAR PIN
SHIELD

214.174

Figure 1-13.—External canopy jettison handle/initiator.


STRUCTURE
INTERNAL HANDLE INITIATOR
QUICK-RELEASE PIN
SQUEEZE-TO-PULL TYPE HANDLE
TRANSFER BOOSTER ASSEMBLY
CAP
SPRING
OUTLET PORT FOR SMDC ASSEMBLY
SEAR PIN
BODY
SAFETY PIN
FIRING PIN

214.175

Figure 1-14.—Internal canopy jettison handle/initiator.

The initiator is a mechanically actuated sealed-in device containing a squeeze-to-pull type of handle, a mechanical firing mechanism, and a transfer booster assembly. The mechanical firing mechanism and transfer booster assembly are identical to those used in the external system. The firing mechanism is secured in the safe position by a safety pin that passes through the handle. The safety pin prevents the handle from being squeezed and pulled.

When the initiator handle is squeezed and pulled for a distance of 0.75 inch, the firing pin separates from the sear pin. From this point, the sequence is identical to the external canopy and hatch jettison sequence.

Shielded Mild and Flexible Confined Detonating Cords

The SMDC and FCDC segments act as the plumbing for the emergency egress system. They provide all internal and external jettison initiators with manifolds and one-way transfers to all explosive charges. Some S-3A aircraft have been modified to incorporate FCDC in place of the SMDC at the four locations where the canopies and/or hatches meet the airframe. The use of the FCDC alleviates the installation problems encountered with SMDC. The SMDC and FCDC focus extremely high velocity and pressures onto the ends of adjacent SMDC segments.

The high reaction speed of 8,000 to 9,000 feet per second makes the SMDC very difficult to initiate from extraneous sources such as sawing, filing, drilling, and hammering. This is because the speed of none of these operations approaches the 8,000 to 9,000 feet per second requirement. From the standpoint of manufacturing and maintenance personnel, the system is virtually inert when safety pins are installed.

The ends of the SMDC, while in storage or not connected in the aircraft, must be capped at all times. Any scaring or deformation of the transfer tip is cause for rejection. Any deformity here will affect the direction the blast force will travel. The tips of the SMDC act as both donor and acceptor to receive and transfer the charge from one SMDC segment to another. The tips contain Hexanitrostilbene II (HSN II) while the cord charge itself is Hexanitrostilbene I, a less sensitive material.

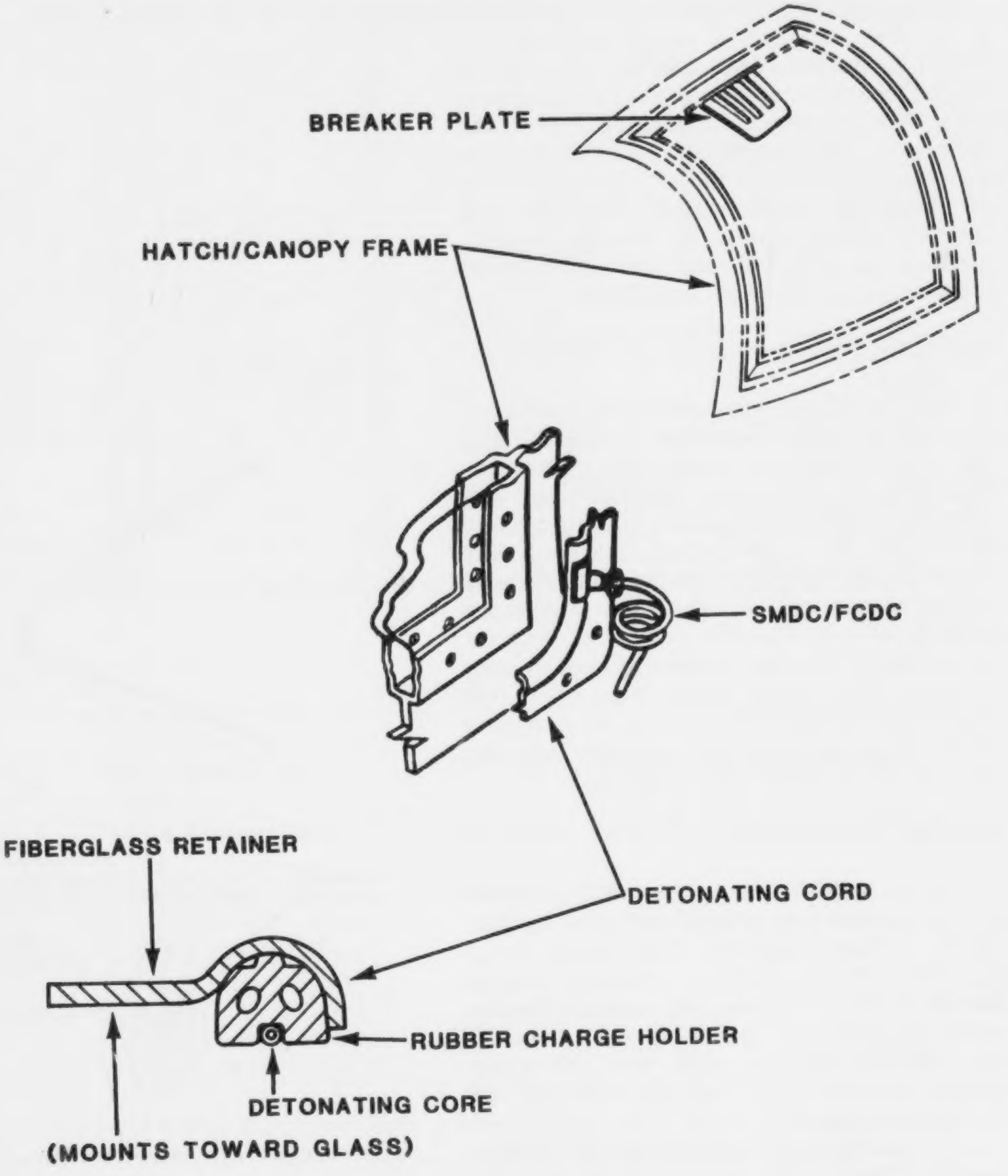
Canopy and Hatch Explosive Charge

An explosive charge is attached to the periphery of the pilot and copilot canopies and the TACCO and SENSO hatches. The explosive charge is a detonating cord, and it is applied directly to the glass on the canopies and/or hatches. Each detonating cord assembly is held in place by a silicone rubber charge holder and fiberglass retainer. (See figure 1-15.) The detonating cord consists of a continuous explosive charge contained in an O-shaped seamless lead sheath. A threaded inlet port (transfer block) is mounted on the fiberglass retainer to allow attachment of the SMDC or FCDC assembly. An SMDC or FCDC connects to the transfer block at the lower front corner of each charge.

Actuation of an emergency ground egress system initiator detonates the SMDC or FCDC screwed into the inlet port of the detonating cord assembly. The detonation wave impacts and initiates the explosive booster charge which, in turn, initiates the detonating cord. Initiation of the detonating cord fractures the stretched-acrylic canopy or hatch along its periphery. The first half of the glass is vaporized by the heat of the flame, which slices a very narrow and deep incision halfway through it. At this point, the shock wave is sufficient to fracture the remaining thickness and spatter the glass outward.

Fillet Severance Explosive Shaped Charge

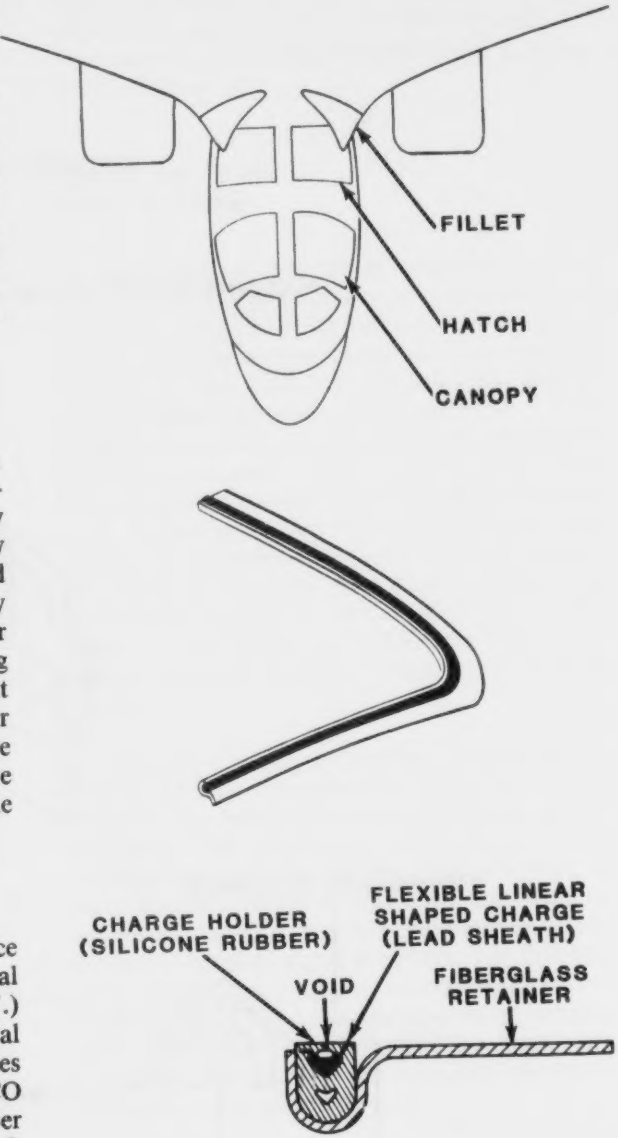
During emergency ground egress, flexible linear shaped charge (FLSC) assemblies sever the S-3A aircraft's left and right upper wing-to-fuselage fillet supports. The FLSC cuts the attached fillet from the aircraft to allow complete egress through the respective hatch.


BREAKER PLATE
HATCH/CANOPY FRAME
SMDC/FCDC
FIBERGLASS RETAINER
DETONATING CORD
RUBBER CHARGE HOLDER
DETONATING CORE
(MOUNTS TOWARD GLASS)

214.176

Figure 1-15.—Hatch/canopy detonating cord assembly.

The FLSC assembly is enclosed in a silicone rubber charge holder which is held in place by a fiberglass retainer. (See figure 1-16.) The FLSC is a continuous explosive charge contained in a V-shaped seamless lead sheath. The silicone rubber shaped charge holder is extremely vulnerable to external damage because of the softness of the material and 0.02-inch material thickness in the area of the FLSC. A cut or tear of the charge holder, which allows the lead sheathed shaped charge to become exposed, destroys the environmental seal and requires replacement of the FLSC assembly.


FILLET
HATCH
CANOPY
CHARGE HOLDER (SILICONE RUBBER)
VOID
FLEXIBLE LINEAR SHAPED CHARGE (LEAD SHEATH)
FIBERGLASS RETAINER

214.177

Figure 1-16.—Fillet FLSC assembly.

SMDC One-Way Transfer

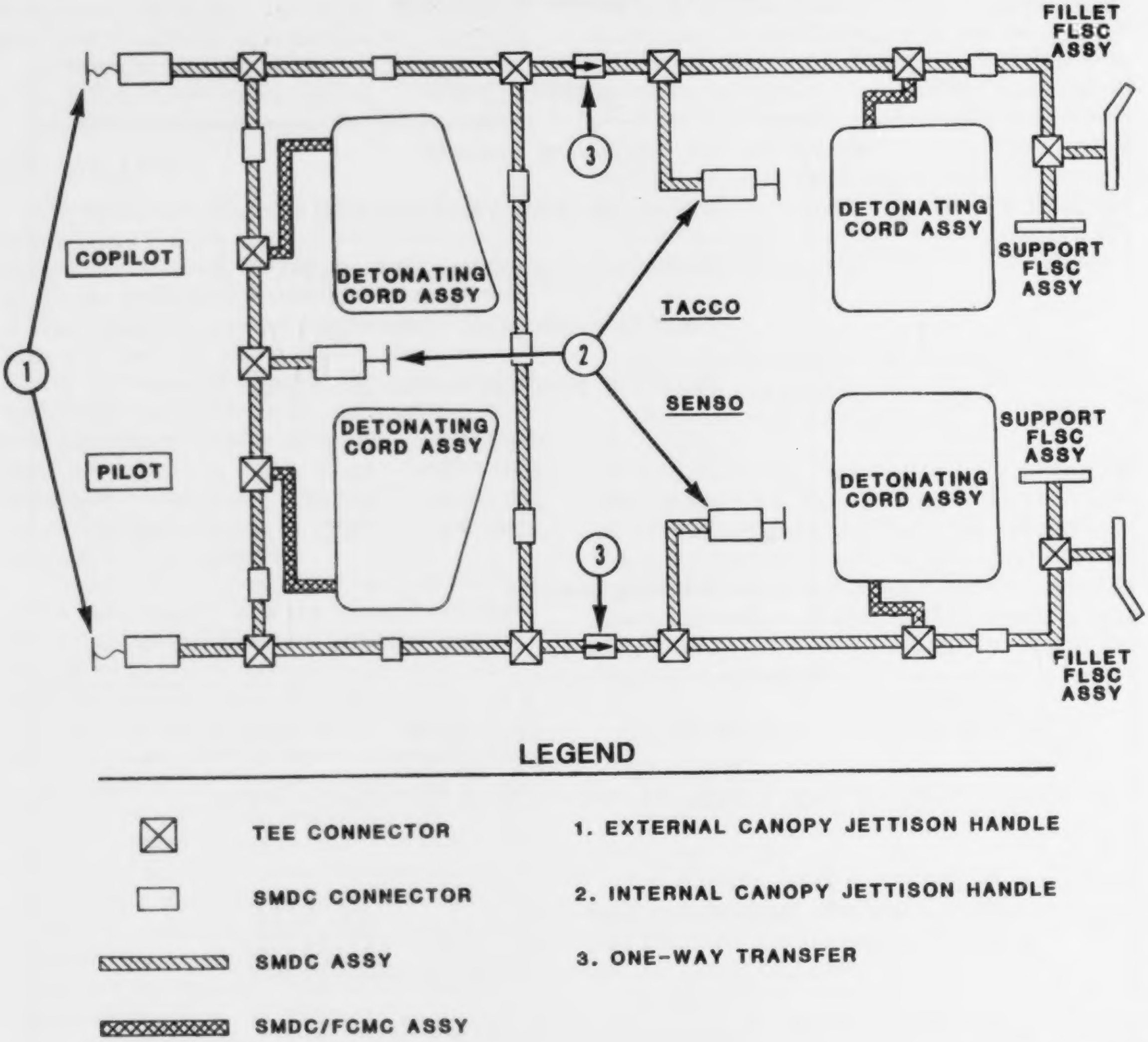
Two SMDC one-way transfers are located on the pilot and copilot bulkhead. The SMDC one-way transfer acts as a check valve or one-way detonating transfer device. The SMDC one-way transfer is a self-contained unit housing a sealed receptacle for dual-shaped charges. Any detonation entering the inlet ports will transfer to the outlet port. Any detonation originating from the aft port (TACCO or SENSO) segment of the SMDC one-way transfer will not transfer forward. This would occur when either the TACCO or SENSO elects to cut the respective hatch. The remaining two windows and the opposite hatch would not be affected.

SYSTEM OPERATION

The S-3A aircraft canopy and hatch severence system contains two external and three internal SMDC initiator handles. (See figure 1-17.) Actuation of the pilot's or copilot's internal handle or either of the two external handles severs the pilot and copilot canopies, TACCO and SENSO hatches, right and left upper wing-to-fuselage fillets, and the right and left wing-fillet supports.

The pilot's and copilot's internal initiator handles transfer a detonation wave signal to the connecting SMDC assemblies, which are routed throughout the cockpit area. In turn, the SMDC assemblies initiate four detonating cord assemblies which are mounted on the periphery of the two canopies and the two hatches. The detonating cord assemblies sever or fracture the stretched-acrylic canopies and hatches. FLSC assemblies, which are simultaneously initiated, sever the two wing-fillet supports and the two upper wing-to-fuselage fillets which infringe into the TACCO and SENSO hatch area.

Actuation of the TACCO or SENSO internal SMDC initiator will sever only the hatch, the


FILLET FLSC ASSY
3
COPILOT
DETONATING CORD ASSY
DETONATING CORD ASSY
SUPPORT FLSC ASSY
TACCO
1
2
SENSO
SUPPORT FLSC ASSY
DETONATING CORD ASSY
PILOT
DETONATING CORD ASSY
3
FILLET FLSC ASSY
LEGEND
TEE CONNECTOR
SMDC CONNECTOR
SMDC ASSY
SMDC/FCMC ASSY
1. EXTERNAL CANOPY JETTISON HANDLE
2. INTERNAL CANOPY JETTISON HANDLE
3. ONE-WAY TRANSFER

214.178

Figure 1-17.—Emergency egress schematic.

upper wing-to-fuselage fillet, and wing-fillet support at the crew station in which the initiator was activated. Explosive one-way transfers located forward of the TACCO and SENSO crew stations prevent the detonation wave from severing the pilot and copilot canopies.

It is virtually impossible to initiate the system at any point other than an initiator handle. As compared to hot-gas systems, this system may be considered immune to ordinary shop hazards. The system is self-sufficient and independent. It depends upon no other system for aid or assistance, and it does not contribute aid, assistance, or sequence to any other aircraft system. The S-3A system is much less susceptible to inadvertent actuation than hot-gas systems, and hence more convenient and safer for maintenance personnel.

Table 1-1.—Derivation of Lot Number

KEY	DEFINITION
a	Lot sequence number
b	Manufacturer's identification symbol
c	Month of production (two digit)
d	Year of production (two digit)
e	Month of production (single alpha) JAN - A MAY - E SEP - J FEB - B JUN - F OCT - K MAR - C JUL - G NOV - L APR - D AUG - H DEC - M
f	Interfix number
g	Lot suffix (alpha)

Example:
Lot Number, Method 1: 11 ABC 0578
Key: (a) (b) (c)(d)
(Note that (c) and (d) will be used to compute service life.)

Example:
*Lot Number, Method 2: XYE 78 E 001-011A
Key: (b) (d) (e) (f) (a)(g)
(Note that (d) and (e) will be used to compute service life.)
*Further details of explanation are available in MIL-STD-1168A.

CARTRIDGES AND CARTRIDGE-ACTUATED DEVICES (CAD)

The types of explosive devices incorporated in egress systems are varied. The AME working with these devices must know how they function, their characteristics, how to identify them, their service-life limitations, and all safety precautions.

The AME who understands the importance of all of these factors and who correctly uses the maintenance manuals is better equipped to supervise and train others. The following manuals are required for the AME to meet the above requirements:

1. *Description, Preparation for Use, and Handling Instructions, Aircrew Escape Propulsion System (AEPS) Devices*, NAVAIR 11-85-1.
2. *General Use Cartridges and Cartridge Actuated Devices for Aircraft and Associated*

Equipment (CADs), NAVAIR 11-100-1.1, NAVAIR 11-100-1.2, and NAVAIR 11-100-1.3.

3. Specific aircraft MIMs.
4. OP 4, *Ammunition Afloat*.
5. OP 5, *Ammunition and Explosives Ashore*.

SERVICE LIFE

The service life of a CAD is the specific period of time that it is allowed to be used. These periods of time are affected by various environmental conditions which have resulted in the assignment of time limits or overage requirements. These limits are shelf life and installed life.

The establishment of service-life limits is based upon design verification tests, qualification tests, and surveillance evaluations. The established limits are approved by the Naval Air Systems Command. Therefore, the establishment of service-life time limits is not arbitrary and must be adhered to as specified.

Prior to deployment to areas that do not permit ready supply and servicing of cartridges or cartridge-actuated devices, an inspection must be made of all CAD's service-life expiration dates. If, during this inspection, it is determined that a CAD will become overage during the period of the deployment, the CAD must be replaced prior to the deployment. Before installation of any CAD, the service-life expiration date of the unit must be checked to ensure that the unit is not overage and will not become overage prior to the next periodic maintenance cycle of the aircraft.

During standard depot level maintenance (SDLM), the expiration dates of all installed CADs must be checked. Those CADs assigned to organizational level for maintenance and have expiration dates prior to the next scheduled inspection after the aircraft is returned to its custodian must be replaced. CADs assigned to depot level for maintenance that have expiration dates falling prior to the next scheduled SDLM should also be replaced. The exception is systems replaced exclusively through the use of a field modification team. Adherence to these procedures will prevent loss of aircraft mission capability due to CAD service-life expiration.

EXPIRATION DATES

To determine service-life expiration dates, both the shelf life and installed life must be computed. First, compute the shelf life of the CAD by using its lot number to determine the month and year of manufacture. Refer to table 1-1 to ensure correct interpretation of the lot number since there are currently two methods used to derive lot numbers. Obtain the established shelf life (number of months and years) for the individual CAD from the NAVAIR 11-100-1 series manual. Add this figure (shelf life) to the month and year of manufacture determined from the CAD lot number. The resulting sum (date) is the shelf-life expiration date of the CAD in question.

Example:

Lot number/date of manufacture	0579
+ Shelf life in years	+ 6
Shelf-life expiration date	0585

Next, determine the installed-life expiration date of the CAD by referring to the NAVAIR 11-100-1 series manual. Obtain the installed-life figure (number of months or years) and add that figure to the date (month) the CAD's hermetically sealed container was opened. The resulting sum (date) will be the installed-life expiration date for the CAD in question.

Example:

Date opened	0879
+ Installed life in months	+ 42
Installed-life expiration date	0283

Then, compare the two dates derived (shelf life and installed life). Whichever date occurs first is the CAD service-life expiration date.

Example:

Shelf life	0585
Installed Life	0283
Service-life expiration date	0283

Since only the month and year are used in computing service-life dates, the date the hermetically sealed container is opened and the expiration date must be computed to the last day of the month involved. If the date the sealed container was opened is not available, the installed life must be computed from the date of manufacture as determined from the lot number.

MARKING EXPIRATION DATES

Before installing a CAD in an aircraft system, both CAD service-life expiration dates (shelf life and installed life) should be computed. The time limit that is exceeded first will be the service-life expiration date of the CAD. The service-life expiration date must be entered into the aircraft logbook.

Use permanent indelible ink for marking CADs with container open dates and service life expiration dates. Do not scribe, scratch, or electroetch these dates as damage will occur to the CAD's corrosion-resistant surface. The marking pen, NSN 7520-00-043-3408, is available from GSA supply and is recommended for this purpose.

When you install a CAD in an aircraft system, a log entry must be made on OPNAV Form 4790/26A as directed by OPNAVINST 4790.2 (Series). When a CAD's hermetically sealed container is opened, the container open date and the service-life expiration date (month and year) must be marked with indelible ink on the container and on each CAD in the container.

SERVICE-LIFE EXTENSION

Contingency service-life extensions for the CADs listed in the NAVAIR 11-100-1 (Series), not to exceed 30 days, may be granted by the commanding officer or his authorized representative. These extensions may be applied to a specific CAD on a one-time-only basis when replacements are not available and failure to extend the service life would disrupt flight operations. The contingency authority is granted on the condition that Naval Ordnance Station, Indian Head, Maryland; NAVAIRSYSCOM, Washington, D.C. and SPCC, Mechanicsburg, Pennsylvania be immediately notified by message or speed letter when such authority is exercised.

When the situation warrants, an additional service-life extension beyond the 30-day contingency extension may be requested by message from the NAVORDSTA. All extensions beyond 30 days must be approved by the NAVORDSTA or NAVAIRSYSCOM. All approved additional service-life extensions will be transmitted by message to the activity making the request. When a service-life extension is granted, an entry must be made in the aircraft logbook. When an aircraft is transferred with a service-life extension in effect, the gaining activity must be notified, and no new contingency service-life extensions may be granted by the commanding officer of the gaining activity.

SERVICE-LIFE CHANGE

The permanent service life of a CAD may be changed only by a rapid action change (RAC), interim rapid action change (IRAC), or formal change to NAVAIR 11-100-1 (Series) as directed by COMNAVAIRSYSCOM, Washington, D.C. If the change affects those items installed in an aircraft, the change will be recorded in the aircraft's logbook. A line will be drawn through the service-life expiration date shown and the new computed expiration date entered citing the authority for the change; for example, message number, rapid action change number, or change number. Each new expiration date will supersede the previous date. The latest expiration date entered in the aircraft logbook will always be the final date the CAD may remain installed in the aircraft.

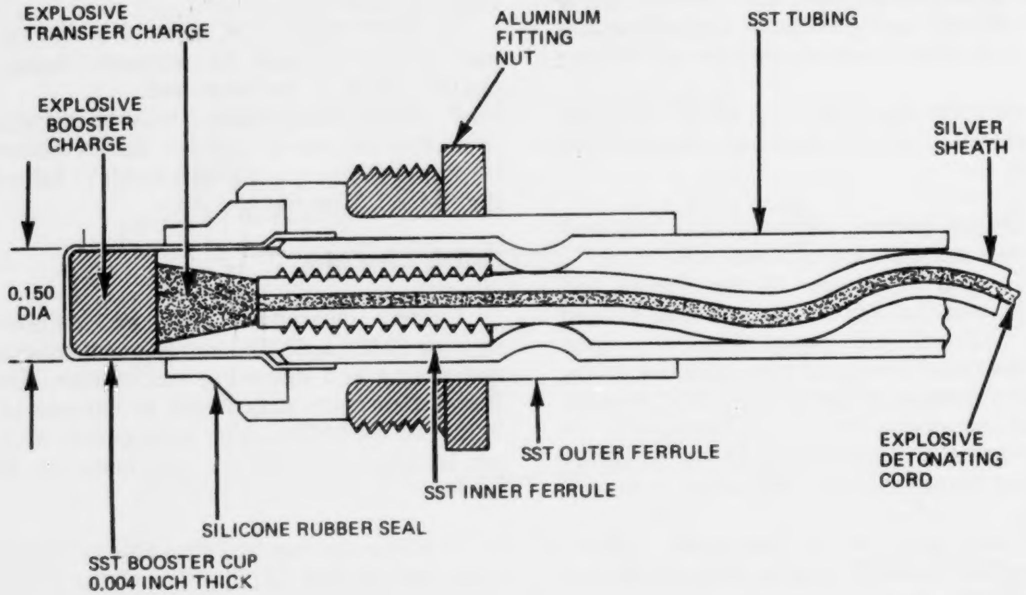
When a contingency service-life extension has been authorized for a specific CAD, the new computed service-life expiration date (month and year) will be added to the original aircraft logbook entry for that CAD. When an additional service-life extension has been granted for a specific CAD, the new service-life expiration date (month and year) will be added to the original aircraft logbook entry.

CAD MAINTENANCE POLICY

CAD maintenance policy prohibits unauthorized maintenance or adjustment to a CAD at any of the three levels of maintenance: organizational, intermediate, or depot. Authorized maintenance actions are limited to removal, inspection, and replacement unless specifically detailed in the aircraft MIM or by a technical directive.

CADs and items of equipment in ejection systems are for one-time use only. They are never to be refurbished or used again after firing. This is equally true of functional equipment, rigid lines, plumbing lines, and hoses. Ejection seats and escape system components that have been utilized in an ejection or fired, regardless of apparent condition, are prohibited from reuse and must be disposed of as directed by OPNAVINST 4790.2 (Series), OPNAVINST 3750.6 (Series), and the applicable CAD and rocket manual.

Because of the extreme stress and strain to the ejection seats and escape system components during ejection, they cannot be reused. This stress could reduce the structural or mechanical



214.179

Figure 1-18.—Standard SMDC/FCDC tip assembly.

reliability of these items. In the case of an inadvertent firing of a cartridge or CAD, all contaminated ballistic lines and devices must be replaced because of the corrosive nature of the explosive.

The service life of wire-braid, teflon-lined hoses installed in ballistic applications is the same as that of the aircraft in which it is installed, unless it is used. A hose is considered to be used if the device to which it is attached is fired, either intentionally or accidentally. If this occurs, the hose and related fittings must be replaced. Before you install a hose or fitting (line, T, elbow, etc.), make sure that it is not contaminated by hydraulic fluid, oil, or a similar type of contaminant. All hoses in the escape system must be inspected for accidental damage at every phased inspection, upon seat removal, after removal of any part of the escape system, and for disconnection of any hose.

When CADs are not installed in an aircraft, the inlet and outlet ports must be sealed with protective closures to prevent the entrance of moisture and foreign matter. For shipping purposes, the safety pins and protective closures provided with the replacement CAD must be returned with the replaced CAD to ensure it is in a safe condition during handling and storage. During ejection system maintenance actions, all disconnected CADs and associated ballistic lines must be protected with flexible plastic plugs that conform to MIL-C-5501/10A and flexible plastic caps that conform to MIL-C-5501/11. NAVAIR 11-100-1.1 provides information relating to these caps and plugs.

SMDC AND FCDC MAINTENANCE AND INSPECTION REQUIREMENTS

To understand the inspection and repair requirements for SMDCs and FCDCs, a brief description is provided in the following paragraphs.

The major components of an SMDC assembly are the stainless steel tubing (SST), outer and inner ferrules, a silicone rubber seal, a 0.004-inch thick SST booster cup, an explosive booster charge, and a sheathed explosive detonating cord. A sectioned drawing of a standard SMDC assembly tip is shown in figure 1-18. The SMDC assemblies used in the canopy and hatch severance system are similar in design and construction except for the length and bend configuration of the stainless steel tubing and silver sheathed explosive detonating cord.

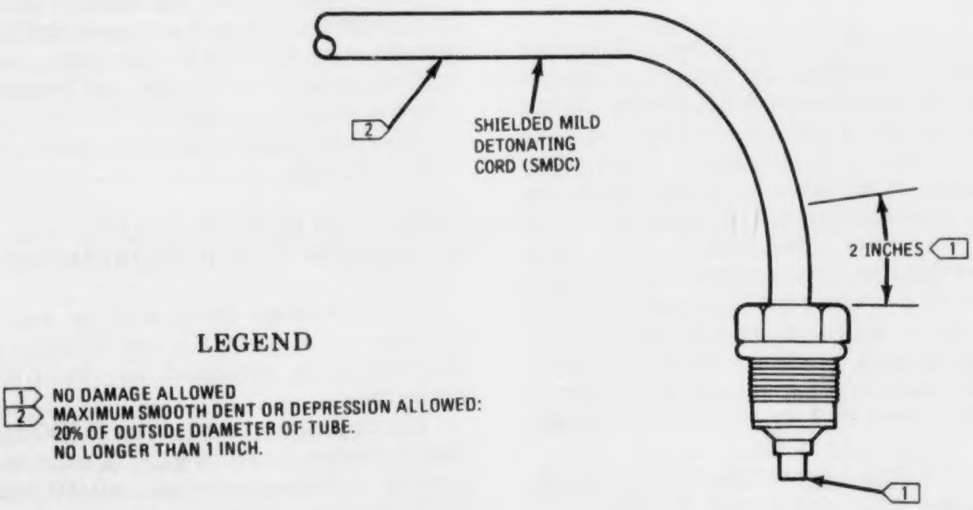
To properly inspect SMDCs and FCDCs, the following list of requirements and precautions is in force:

1. Ensure ground safety devices required during maintenance are correctly installed.
2. To prevent damage to the SMDC and FCDC booster tips, extreme caution must be used during removal and installation. All open connections must be capped with protective covers to prevent damage to SMDC and FCDC booster tips and contamination of open fittings.
3. Inspect each SMDC and FCDC assembly fitting nut for deformation, flattening, or wrench cutting.
4. There must be no corrosion, cracks, discoloration, flatness, gouges, holes, improper bends, kinks, sharp dents, splits, swelling, or wrinkles in an SMDC or FCDC assembly.
5. Smooth dents or slight depressions in SMDC or FCDC assemblies, tubing, or hoses are permitted if they do not exceed specified maximum limits. If the maximum limits are exceeded, the SMDC or FCDC assembly must be replaced. (See figure 1-19.)
6. SMDC and FCDC assemblies that do not pass inspection must be replaced. Repair of SMDC tubing is not permitted.
7. Proper clamp spacing must be maintained to prevent damage to SMDCs due to vibration. Improper clamp spacing may result in failure of the SMDC. (See figure 1-20.)

SMDC Clearance

Correct clearances must be maintained between SMDCs, SMDC and adjacent structures, and tubing and operating mechanisms. Insufficient clearances may result in damage to or failure of the SMDC. You must ensure SMDCs are installed with proper clearances as listed below:

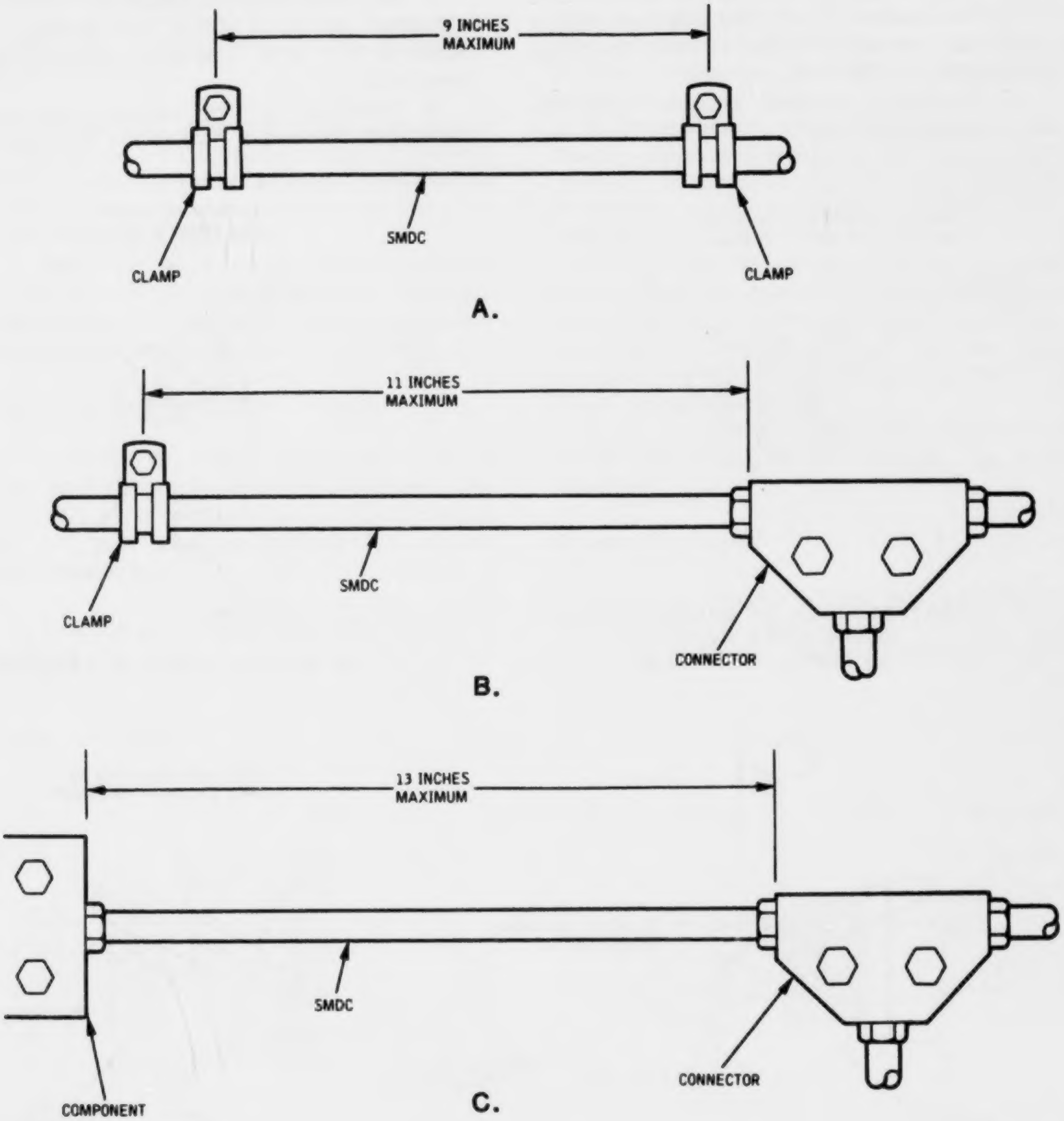
1. Minimum required clearance between any supported section of SMDC and the adjacent structure is 1.00 inch.
2. Minimum required clearance between any straight, unsupported section of SMDC and adjacent structure is 0.25 inch.
3. Minimum required clearance between any two parallel SMDCs is 0.10 inch.



LEGEND

1 NO DAMAGE ALLOWED
2 MAXIMUM SMOOTH DENT OR DEPRESSION ALLOWED: 20% OF OUTSIDE DIAMETER OF TUBE. NO LONGER THAN 1 INCH.

Figure 1-19.—SMDC damage limits.


9 INCHES MAXIMUM
SMDC
CLAMP
CLAMP
A.
11 INCHES MAXIMUM
SMDC
CLAMP
CONNECTOR
B.
13 INCHES MAXIMUM
SMDC
COMPONENT
CONNECTOR
C.

214.180

Figure 1-20.—SMDC clamp spacing.

4. Minimum required clearance between any two supported nonparallel SMDCs is 0.10 inch.

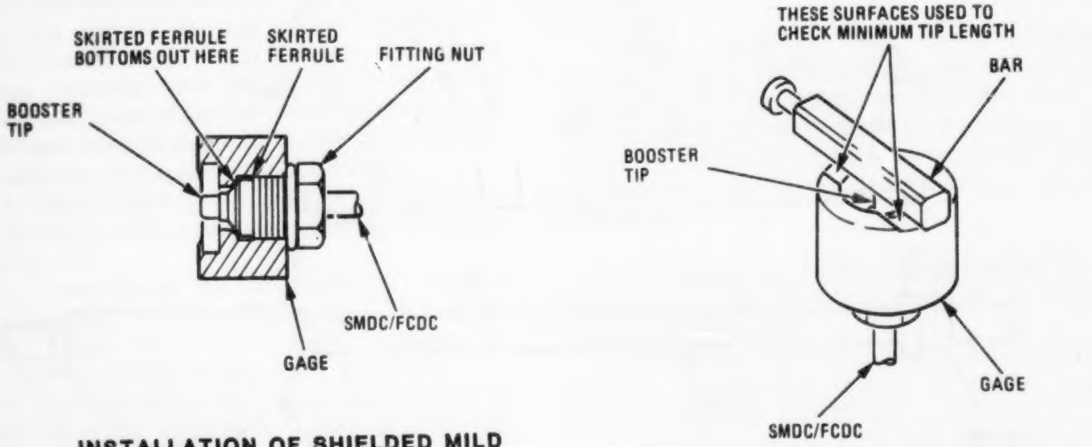
5. Minimum required clearance between any two unsupported nonparallel SMDCs is 0.10 inch.

6. Minimum required clearance between any supported section of SMDC and any operating mechanism is 1.00 inch.

7. Minimum required clearance between any unsupported section of SMDC and any operating mechanism is 1.00 inch throughout the full operating range of the mechanism.

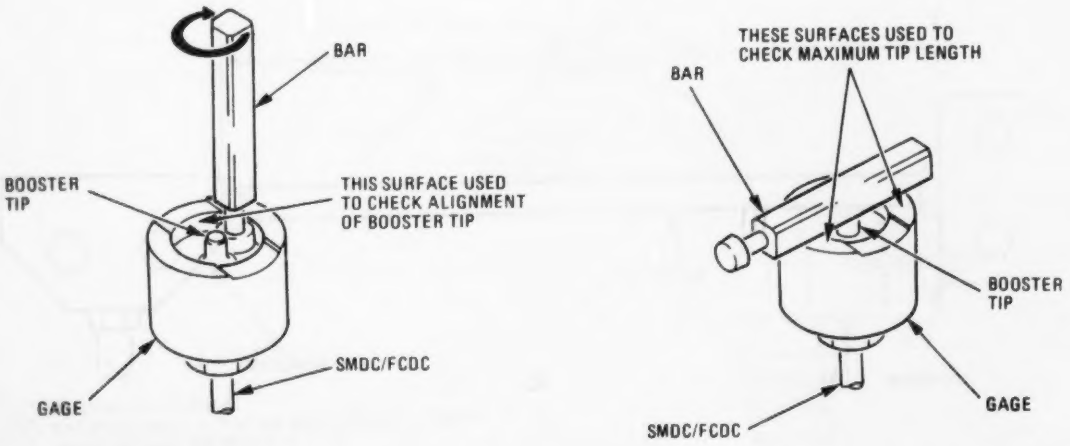
8. Minimum required clearance between any supported section of SMDC and electrical wire bundle is 0.25 inch, if both are clamped in the same vicinity.

9. Minimum required clearance between any unsupported section of SMDC and electrical wire


SKIRTED FERRULE BOTTOMS OUT HERE
SKIRTED FERRULE
FITTING NUT
BOOSTER TIP
SMDC/FCDC
GAGE
THESE SURFACES USED TO CHECK MINIMUM TIP LENGTH
BAR
BOOSTER TIP
GAGE
SMDC/FCDC

INSTALLATION OF SHIELDED MILD DETONATING CORD TIP IN INSPECTION GAGE

TIP CHECK–MINIMUM LENGTH


BAR
BOOSTER TIP
THIS SURFACE USED TO CHECK ALIGNMENT OF BOOSTER TIP
SMDC/FCDC
GAGE
THESE SURFACES USED TO CHECK MAXIMUM TIP LENGTH
BAR
BOOSTER TIP
GAGE
SMDC/FCDC

TIP ALIGNMENT CHECK

TIP CHECK–MAXIMUM LENGTH

214.181

Figure 1-21.—SMDC/FCDC booster tip inspection.

bundle is 0.25 inch above the wire bundle or 1.00 inch below the wire bundle.

Booster Tip and Ferrule Inspection

Inspection requirements for SMDC booster tips are as follows:

1. No damage, however slight, is permitted on SMDC or FCDC booster tips or skirted ferrule. If any damage is observed, the SMDC or FCDC must be replaced. Shiny surfaces on booster tips are permitted.
2. If the ferrule is loose or partially swivels, the SMDC or FCDC must be replaced. This may be determined by holding the skirted ferrule and attempting to rotate it radially.

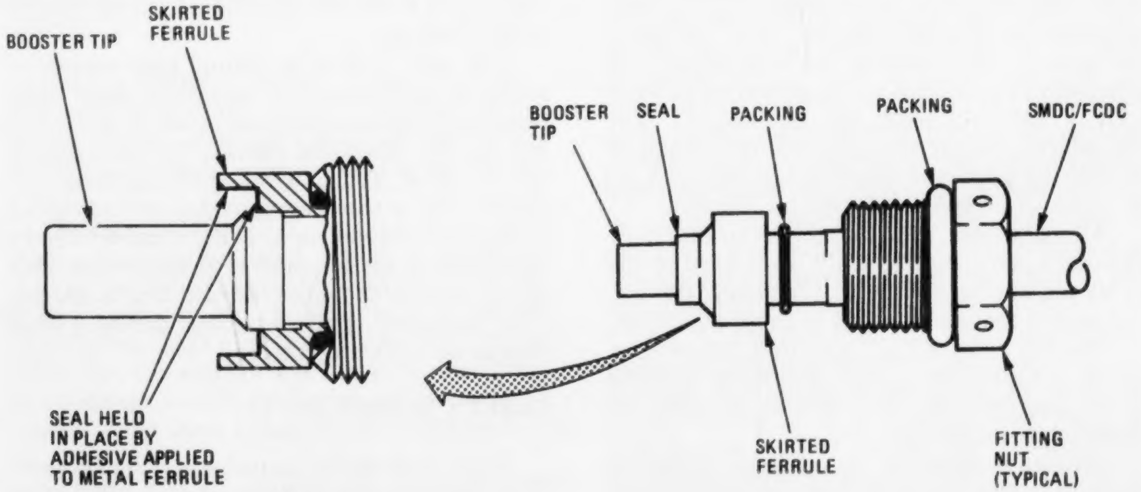
Detonating Cord Inspection Gage Set

The SMDC or FCDC booster tip must be inspected for correct length and alignment. (See figure 1-21.) Use the detonating cord inspection gage set, part number A51562680-1, in the following manner:

1. Use the correct size gage for booster tip inspection.
2. Screw the detonating cord inspection gage onto the fitting nut until the skirted ferrule bottoms in the gage.
3. Place the flat surface of the bar against the recessed portion of gage. If the booster tip is too short, the bar will contact flats on both sides of the gage. In this case, the SMDC or FCDC must be replaced.
4. Place the flat surface of the bar against the raised portion of the gage. If the booster tip is too long, the bar will contact the tip and one side of the gage. Again the SMDC or FCDC must be replaced.
5. Place the cylindrical end of the bar in the space between the gage and the booster tip. If the booster tip is not concentric within 0.010 inch, tolerance in radius, the bar will not pass completely around the booster tip. The SMDC or FCDC must be replaced.
6. If a condition exists that requires the SMDC or FCDC to be replaced, tag it as defective.

Booster Tip Repair

Repair of SMDC booster tips is limited to replacement of packings on the tips and replacement of a damaged seal. (See figure 1-22.)



214.182

Figure 1-22.—SMDC/FCDC booster tip repair.

The following instructions apply to the repair of booster tips:

1. Visually inspect the seal.
2. If it is damaged, remove the seal.
3. Use a clean cloth moistened with Nozel number 18 solvent to clean the existing adhesive.
4. Apply a thin coat of RTV-102 adhesive to the inside diameter of the skirted ferrule. Ensure that the adhesive does not come in contact with the booster tip.
5. Install the seal on the tip.
6. Allow the tip to dry and reinstall the SMDC. Tighten the SMDC with your fingers to prevent stripping of the nut.
7. Tighten the SMDC or FCDC fitting nut to the proper torque in accordance with the MIMs and safety it with lockwire.
8. Quality assurance personnel will inspect all SMDC and FCDC fitting nut torquing and safetying.

ORDNANCE CERTIFICATION PROGRAM

All personnel involved in the handling, preparation, inspection or adjustment of live ammunition must be qualified and certified for the task involved in accordance with OPNAVINST 8023.2 (Series) as augmented by the fleet commander, type commander, and NAVSEA Instructions. Only reliable, mentally sound, and physically fit personnel will be permitted to work with or use explosives and ammunition. The procedures and circumstances for revocation of an individual's qualification and certification are set forth in OPNAVINST 8023.2 (Series).

All personnel who handle ammunition or explosives must be frequently instructed in the safety precautions, methods of handling, storage, and uses of that ammunition or those explosives. No one will be permitted to inspect, prepare, or adjust live ammunition and explosives until the duties, preparations, and hazards involved are thoroughly understood.

Personnel assigned to operate ordnance equipment must receive, prior to commencing operation, a thorough indoctrination in general safety precautions applicable to ordnance and in the specific precautions applicable to the equipment. New or inexperienced personnel must not be permitted to work independently on explosive ordnance of any kind. They must be under the direct and constant supervision of skilled, experienced, and certified personnel until adequate experience is acquired.

Familiarity with any work, even though dangerous, may lead to carelessness. Therefore, personnel who supervise or perform work in connection with the handling, inspection, installation, and care of cartridges must observe the following restrictions:

1. Ensure that all applicable regulations are rigidly observed.
2. Carefully supervise the activities of all subordinate personnel.
3. Inform all personnel of the constant need for using the utmost vigilance in the performance of their work.

ORDNANCE LOGBOOK AND INFORMATION SHEET

Most AME supervisors that are assigned to commands that handle ordnance or ejection seats should be thoroughly knowledgeable about aircraft logbooks and the aeronautical equipment service record (AESR) of the logbooks. These are covered in the *Aviation Maintenance Ratings 1 & C*, NAVEDTRA 10343, and OPNAVINST 4790.2 (Series).

The AME supervisor should keep records of explosive devices and their expiration dates. Some commands incorporate local cards or sheets that include the functional checks, pin protrusions, torque valves, and CDI and QAR requirements. Blank cards or sheets are provided for individuals to sign upon completion. MRC numbers can be incorporated for assignment to ensure that each step is completed before the next step is started. This procedure is advantageous during a shift change or work stoppage.

SAFETY SUMMARY

Cartridges used in cartridge-actuated personnel escape devices must function perfectly the first time. Malfunction of the device, or failure to fire when needed, usually results in severe injury to or death of the pilot and crew member(s), and damage to or destruction of the aircraft.

Cartridges are carefully designed and manufactured, but their performance in cartridge-actuated devices is dependable only when they have been properly handled and installed. Care must be observed to maintain the devices in perfect condition.

Since individual cartridges cannot be tested, the responsibility for proper functioning is in the hands of the supervisor and the personnel who maintain them. The quality and reliability of an ejection system are largely dependent on the supervisors and the mechanics who maintain the systems.

Safety Precautions

Because the safety precautions presented in this chapter are basic and general in nature, the AME is encouraged to consult other publications for the specifics related to the task at hand.

SMOKING.—Smoking must be prohibited in any magazine, building, vehicle, or other conveyance or area containing explosives or ammuntion; where operations involving such material are conducted; and in the immediate vicinity of handling or loading operations involving explosives or ammunition. Smoking areas may be designated by the commanding officer.

MAGAZINES.—Naked lights, matches, lighters or other spark, flame, or heat producing devices must never be taken or stowed in magazines or other areas containing explosives.

CARTRIDGES.—If a cartridge is removed from a cartridge-actuated device, it should be marked for identification so it can be reinstalled in the same device. A deformed or dented cartridge or CAD might not fit properly in the equipment for which it was designed; therefore, in handling, special care must be exercised to prevent them from being struck or dropped.

ASSISTANCE.—Under no circumstances should any person reach within or enter an enclosure for the purpose of servicing or adjusting explosive equipment without the immediate presence or assistance of another person capable of rendering aid.

CONTAMINATION.—Operational activities must not apply anticorrosive materials to CADs. When anticorrosive material is being applied to any item in the vicinity of CADs or associated equipment, every precaution will be exercised to prevent contamination of the CADs or associated equipment. Contamination of CADs can have a detrimental effect on the function of the system.

SHOCK.—Electrically initiated cartridges must be kept away from stray electrical currents. Under certain conditions, dangerous potentials can be stored in circuits after the power source has been disconnected because of charges retained by capacitors. To avoid casualties, you should always disconnect the power source and discharge and ground circuits prior to touching them.

REPORTING.—All malfunctions, discrepancies, and accidents involving CADs must be reported by message to NAVORDSTA, Indian Head, Maryland in accordnance with OPNAVINST 4790.2 (Series). If the suspected defect is with the CAD, the message must be addressed to NAVORDSTA for action. If the report describes an inadvertent actuation of an aircraft system resulting in the CAD functioning normally, the action copy of the report must be submitted to the cognizant field activity (CFA) for the aircraft with an information copy to NAVORDSTA, Indian Head, Maryland. Accidents and incidents involving CADs may require reporting in accordance with OPNAVINST 3750.6 in addition to the OPNAVINST 4790.2 (Series). Submission of the reports required by the maintenance instruction does not satisfy the requirements of the safety instruction. If dual reporting is required, you should ensure the reports are adequately cross-referenced to satisfy the requirements of all commands involved.

All CADs suspected of being discrepant, malfunctioning, or involved in an accident or incident must be clearly identified and turned in to the station or ship's ordnance or weapons department marked "hold for 30 days for engineering investigation (EI) pending disposition instructions." The report should contain the turn-in document number, and it should identify the activity holding the material. If CFA response is requested, NAVORDSTA will respond with complete disposition and shipping instructions.

If the response is not received within 15 days, a follow-up message must be sent to verify receipt of the original report by NAVORDSTA.

All cartridges and cartridge-actuated devices must be handled as live ammunition. Cartridges or cartridge-actuated devices that have been fired may retain an explosive residue capable of presenting a hazardous condition. The ejection seat, parachutes, and survival equipment with installed CADs must be stored and handled by authorized personnel only. They must be stored and handled only in an area designated and approved by the maintenance officer.

Safety devices and pins must be kept in good condition and used only with the individual CAD for which they were designed. When a loaded cartridge-actuated device is not in use, the safety device or pin must be installed. Substitute materials must not be used to replace safety pins installed in CADs. If inlet and outlet ports are present in a CAD, they must be covered with a protective cap. If a protective cap is not available, you should use the shipping cap when the device is not installed.

Except in an emergency and by proper authority, CADs must not be installed in or removed from aircraft during fueling or defueling operations.

CADs installed on or in ejection seats, parachutes, or survival equipment that remain installed during maintenance evolutions do not require removal prior to storage in the maintenance space. CADs removed from ejection seats, parachutes, or survival equipment must be properly safetied and protective caps and plugs must be installed as required. Removed CADs must be stored in a ready-service magazine approved for Class C ammunition storage unless they are required for reinstallation on the same day. If the CADs are required for reinstallation on the same day, they must be stored in the area approved and designated by the maintenance officer.

MARKINGS.—When the sealed inner container of a CAD is opened, all CADs in the container must be stenciled with indelible ink to show the computed container open date and expiration date. Before inserting a cartridge in a cartridge-actuated device, the cartridge expiration date must be checked to ensure the cartridge will not become overage before the next periodic maintenance of the aircraft in which it is to be installed.

Problem Areas

The Naval Safety Center receives messages of interest to AMEs. The following paragraphs contain a few examples of some of the problems that have been received by the safety center related to ejection seats.

Several instances have been reported concerning cartridges stuck in ejection seat systems. This problem is not new, but it still warrants concern as the problem still exists. Some of the causes of stuck CADs are overtorquing during installation, incorrect tools used for removal and installation, and the use of incorrect seals or lubricants. To avoid stuck CADs, you should ensure that correct procedures and parts are used during installation. If correct procedures are followed, the CADs should not stick and removal with the prescribed tool should be possible.

Another message described two ejection seats that required 150 man-hours each to treat for corrosion. This is a tremendous amount of time to spend for corrosion control on ejection seats. If a unit waits until a major inspection cycle to treat a system for corrosion, it will require extensive man-hours to remove corrosive properties that have formed. Most metals will corrode, but the corrosion can be controlled. Remember, the 7-, 14-, and 28-day inspections provide the opportunity to discover corrosive areas and to treat them before they become major problems.

Ejection seats and ejection system components that have been used in an ejection or fired are prohibited from being used to locally construct squadron or unit training services. The policy of the Chief of Naval Operations (CNO) is that ejection seat maintenance and aircrew training will be provided in a formally structured course of instruction.

An aircraft's ejection system is an aviator's last resort to save his/her life when disaster is imminent. The system must be maintained with the highest standards of workmanship possible.

CHAPTER 2

MARTIN-BAKER SJU-5/A EJECTION SEAT

Martin-Baker ejection seats are used in several naval aircraft. The F-4 uses the MK H-7 seat. The A-6 uses the MK GRU-7. The F-14 uses the MK GRU-7A/1 and 7A/2 in the forward and aft seats respectively. The Martin-Baker SJU-5/A ejection seat is used in the F/A-18 and the TF/A-18 rear cockpit. This chapter will discuss the SJU-5/A single-seat system used in the F/A-18.

SYSTEM DESCRIPTION

The SJU-5/A ejection seat is a ballistic catapult and rocket system that provides the pilot with a quick and safe means of escape from the aircraft. The seat system includes an initiation system that jettisons the canopy, positions the pilot for ejection, and fires the seat catapult. Canopy breakers on the top of the seat provide the capability to eject through the canopy should it fail to jettison.

As the seat ejects from the aircraft, a rocket motor on the bottom of the seat is fired. Then a drogue gun is fired to deploy two drogue parachutes. These parachutes either remain attached to the top of the seat or they are released to deploy the main parachute, depending upon the altitude and the number of g's applied to the seat. An automatic time release mechanism opens the main parachute container and releases the drogue parachutes that deploy the main parachute.

SYSTEM COMPONENTS

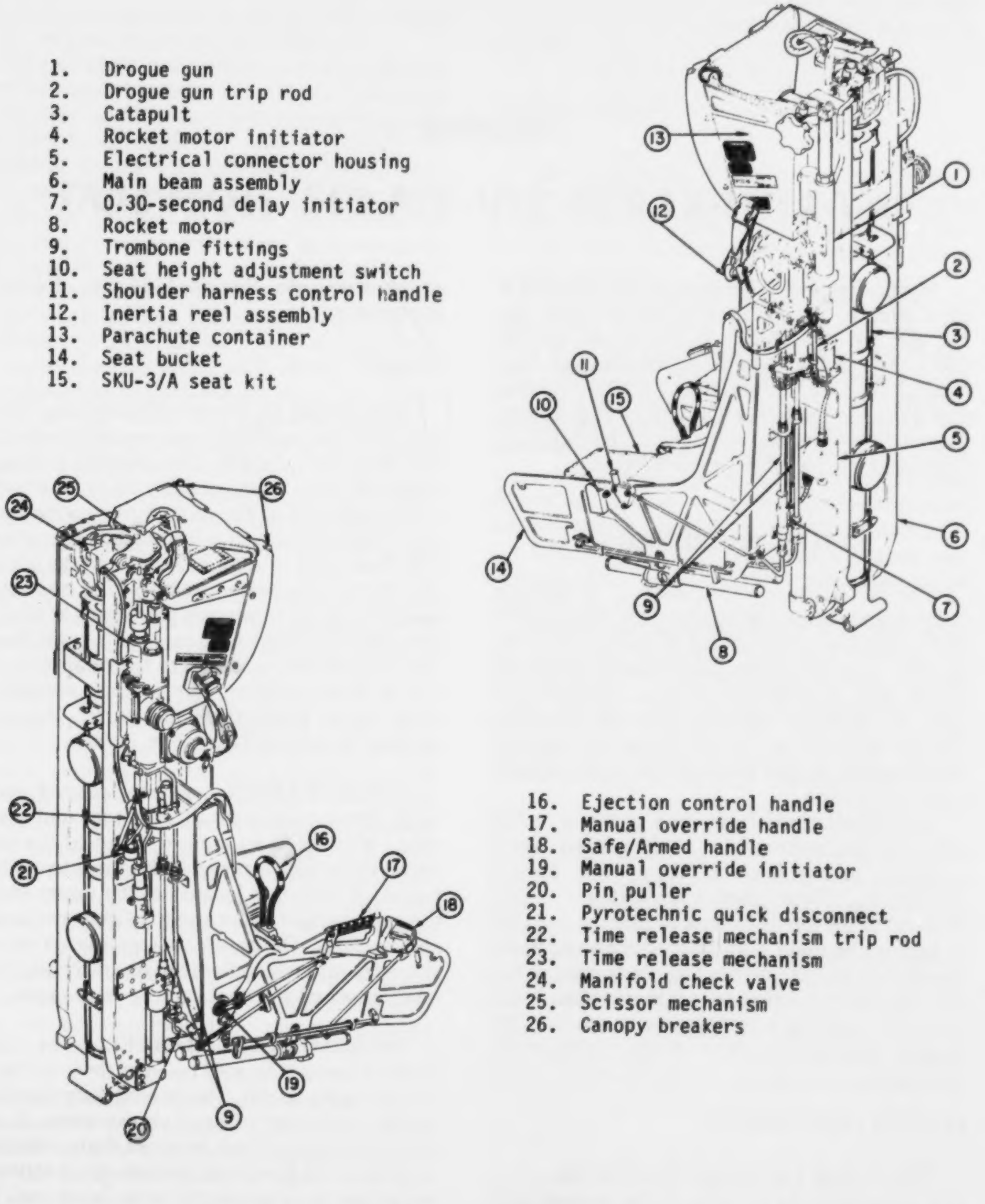
The ejection seat system, shown in figure 2-1, provides support for the pilot during normal flight conditions and a method of escape from the aircraft during emergency conditions. Its components are discussed in the following paragraphs.

Catapult

The catapult (3) is a cartridge-actuated device that provides the initial force required to eject the seat from the aircraft. The catapult is located within the main beam assembly (6) and is attached to the bulkhead of the cockpit by two mounting lugs. The ejection seat is installed on the catapult with three pairs of slippers located on the inboard side of the main beam assembly. The main beam assembly fits into catapult guide rails located on the outboard sides of the catapult's outer barrel. The ejection seat is locked to the catapult by the top latch mechanism. The catapult consists of three major parts: the inner barrel, the intermediate barrel, and the outer barrel.

INNER BARREL.—A neck-shaped piston head, fitted with a set of expander and piston rings, is attached to the lower end of the inner barrel to provide a gas seal with the intermediate barrel. A breech is located at the upper end of the inner barrel for the primary firing mechanism and cartridge. The breech has a groove on the outside edge into which the plunger of the top latch mechanism of the ejection seat is engaged.

INTERMEDIATE BARREL.—The intermediate barrel is located between the inner barrel and the outer barrel. The intermediate barrel increases the length of catapult extension. It also restrains bending loads incurred during ejection. A piston head fitted with two sets of six expander and piston rings is attached to the lower end. The piston head serves as a gas seal between the intermediate barrel and the outer barrel. A guide



1. Drogue gun
2. Drogue gun trip rod
3. Catapult
4. Rocket motor initiator
5. Electrical connector housing
6. Main beam assembly
7. 0.30-second delay initiator
8. Rocket motor
9. Trombone fittings
10. Seat height adjustment switch
11. Shoulder harness control handle
12. Inertia reel assembly
13. Parachute container
14. Seat bucket
15. SKU-3/A seat kit
16. Ejection control handle
17. Manual override handle
18. Safe/Armed handle
19. Manual override initiator
20. Pin puller
21. Pyrotechnic quick disconnect
22. Time release mechanism trip rod
23. Time release mechanism
24. Manifold check valve
25. Scissor mechanism
26. Canopy breakers

214.203

Figure 2-1.—Martin-Baker SJU-5/A ejection seat.

bushing is riveted to the upper end of the intermediate barrel to keep the inner barrel steady during extension. The guide bushing rivets are sheared by the neck-shaped piston head of the inner barrel during ejection. This allows separation of the inner and intermediate barrels. Twelve pressure rings are installed on the intermediate barrel to absorb the inertia forces encountered during barrel separation.

OUTER BARREL.—The outer barrel houses the intermediate and inner barrel assemblies. Two breeches are located on the aft side to accept the auxiliary cartridges. Two guide rails are bolted on the outboard sides of the outer barrel. The lower end is used to attach the catapult to the aircraft. The upper end has a square aperture to engage the plunger of the top latch mechanism. The upper fitting is threaded for the guide bushing that retains the intermediate barrel. The guide bushing is locked in place by a dowel screw.

Manifold Check Valve

The manifold check valve, shown in figures 2-1 and 2-2, provides an interface between the ejection seat and the catapult. The manifold check valve is mounted to the top of the catapult. The valve is held against the primary firing mechanism by a spring-loaded plunger and a retaining pin. The valve contains two inlet ports which connect the hoses from the 0.30- and 0.30/0.75-second delay initiators. Internal check valves ensure that 400 to 600 psi gas pressure is maintained at the catapult primary firing mechanism.

Main Beam Assembly

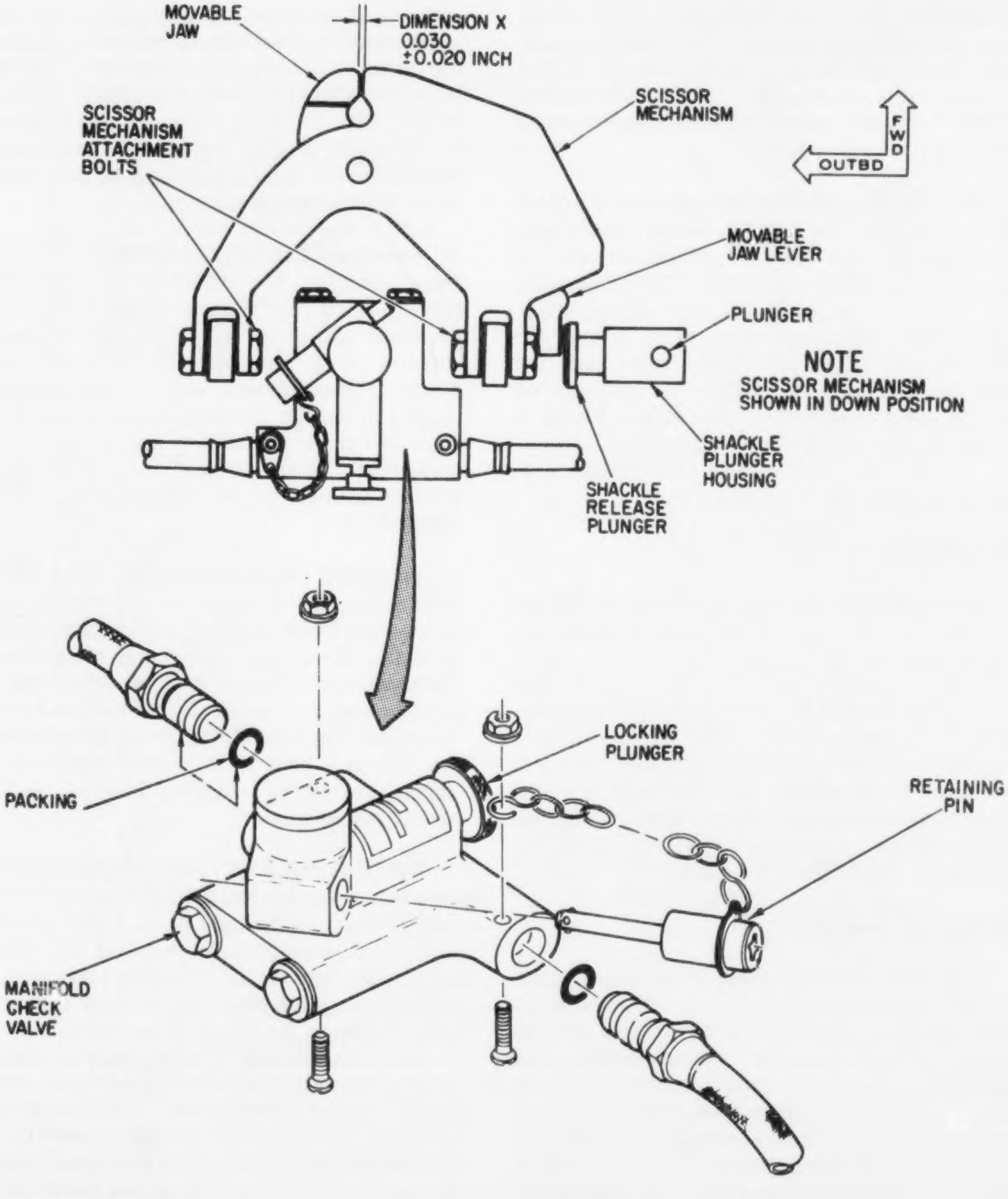
The main beam assembly is the main structure of the ejection seat (figure 2-1). The main beam assembly consists of left and right vertical beams bridged by three cross members. The assembly supports the major components of the ejection seat. Three slippers are bolted to the inboard side of each beam to engage the guide rails on the catapult outer barrel. The upper cross member is used to hold and correctly position the top of the catapult. This member withstands the full thrust of the catapult during the ejection sequence. The bolts that attach the upper cross member to the main beam assembly also attach the top latch mechanism to the left beam. The inertia reel (12) and the upper attachment for the seat height actuator are mounted to the center cross member. Two tabular tubes are secured to the center and lower cross members. The tubes have two sliding runners that attach to the seat bucket. The seat height actuator rod is attached to the lower sliding runner. The components attached to the main beam assembly are discussed in the following paragraphs.

TOP LATCH MECHANISM.—The main beam assembly is secured to the catapult by the top latch mechanism, which is located on the upper end of the left beam. The mechanism consists of a housing with a spring-loaded plunger. The inboard end of the plunger is shaped to engage the catapult inner barrel. The outboard end is threaded to accept the top latch handwheel. When the handwheel is installed, it permits removal of the ejection seat from the catapult.

SCISSOR MECHANISM.—The scissor mechanism, shown in figure 2-2, is located on top of the main beam assembly upper cross member. It retains the drogue parachutes after they are deployed and prevents deployment of the personnel parachute until a safe altitude and g-force is reached. The scissor mechanism has a moveable jaw, which is held in the closed position by the shackle plunger of the upper body of the time-release mechanism.

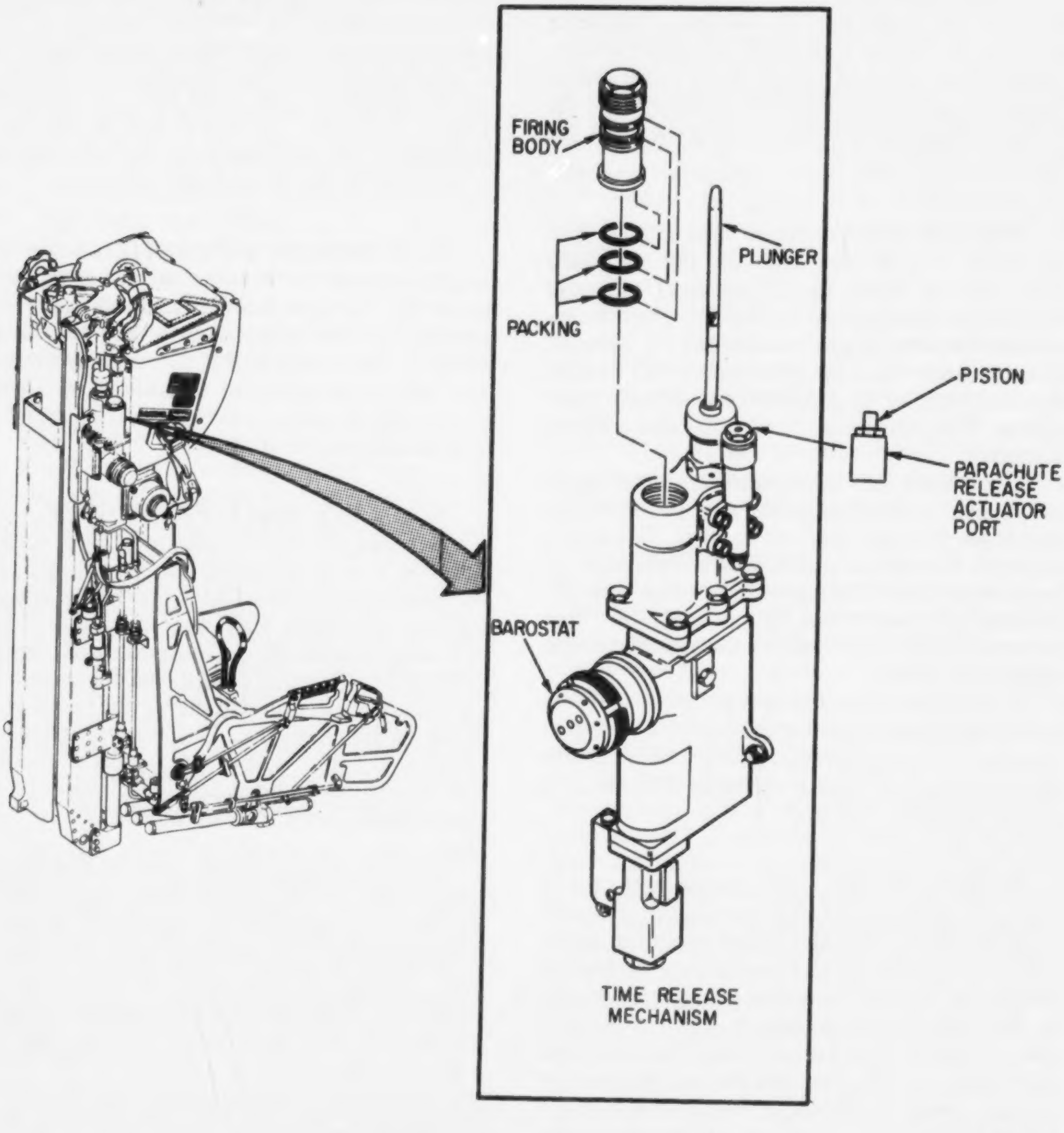
TIME-RELEASE MECHANISM.—The time-release mechanism (TRM) is mounted on the outboard side of the right beam. (See figure 2-3.) The TRM automatically releases the drogue parachutes, deploys the personnel parachute, and releases the pilot from the ejection seat at the proper time in the ejection sequence.

The TRM consists of a time-delay mechanism, barostat assembly, barostatic g-controller, spring-loaded firing mechanism, connecting rod, cartridge, and a shackle plunger assembly. The shackle plunger is secured in the scissor shackle plunger housing to lock the scissor mechanism in the closed position, as shown in figure 2-2. In this position, the drogue shackle is secured to the ejection seat. Gas lines connect the TRM to the


MOVABLE JAW
DIMENSION X 0.030 ±0.020 INCH
SCISSOR MECHANISM
SCISSOR MECHANISM ATTACHMENT BOLTS
FWD
OUTBD
MOVABLE JAW LEVER
PLUNGER
NOTE
SCISSOR MECHANISM SHOWN IN DOWN POSITION
SHACKLE PLUNGER HOUSING
SHACKLE RELEASE PLUNGER
LOCKING PLUNGER
PACKING
RETAINING PIN
MANIFOLD CHECK VALVE

214.204

Figure 2-2.—Scissor mechanism and manifold check valve.


FIRING BODY
PLUNGER
PACKING
PISTON
PARACHUTE RELEASE ACTUATOR PORT
BAROSTAT
TIME RELEASE MECHANISM

214.205

Figure 2-3.—Time release mechanism.

manual override initiator and to the secondary cartridge of the drogue gun. A piston located on top of the upper body engages the parachute mechanical lock to secure the personnel parachute.

The TRM 1.5-second time-delay mechanism delays pilot and seat separation and deployment of the personnel parachute until the drogue parachutes stabilize and decelerate the ejection seat. The barostat assembly delays the deployment of the personnel parachute until the pilot and the ejection seat descend to 14,500 feet. This delay prevents prolonged descent in the upper atmosphere. When ejection occurs above 7,500 feet, a barostat g-controller delays the deployment of the personnel parachute until deceleration loads are less than 3 g's.

DROGUE GUN.—The drogue gun, shown in figure 2-1, is mounted on the outboard side of the left beam. The drogue gun (1) deploys the drogue parachutes during the ejection sequence. The drogue gun incorporates a 0.5-second delay to ensure that the ejection seat has cleared the cockpit prior to deploying the drogue parachutes. The gun consists of a body and a barrel assembly.

The drogue gun body contains a time-delay mechanism, a spring-loaded firing pin, and two cartridges (primary and secondary). The barrel assembly contains a piston that is held in place by a shear pin. The barrel holds the primary cartridge and water seal. The primary cartridge is mechanically fired by a trip rod attached to the cockpit bulkhead.

A chamber connected by a gas passage to the barrel holds the secondary cartridge and a gas-operated firing mechanism. This chamber ensures that actuation of either cartridge will fire the piston from the barrel.

INERTIA REEL.—The inertia reel (12) is mounted on the center cross member of the main beam assembly. During normal operation in the UNLOCK position, the inertia reel is free to extend or retract as required by the pilot's movements, but an automatic lock feature will prevent rapid forward movement. When the rapid movement ceases, the inertia reel returns to normal operation. When the inertia reel is in the LOCKED position, it will retract the straps but will not allow them to extend. When the ejection sequence is initiated, a pyrotechnic cartridge is used to activate the inertia reel. This retracts and locks the pilot into the correct position for ejection.

ROCKET MOTOR INITIATOR.—The rocket motor initiator (4) is mounted on the outboard side of the left beam. The rocket motor initiator consists of a cartridge chamber, a firing mechanism, and a coiled static line. The chamber is attached to the trombone assembly (9) by an outlet connector. The static line is coiled into a plastic container. The upper end of the line is attached to the quadrant lever and the lower end is attached to the drogue gun trip rod.

SEAT HEIGHT ACTUATOR.—The seat height actuator is mounted in the main beam assembly forward of the catapult gun. The actuator permits adjustment of the seat bucket within a vertical travel of approximately 5 inches. The seat height actuator consists of an electric motor and housing, gearbox, bearing housing, and jackscrew assembly.

AIRCRAFT SEAT PARACHUTE.—The aircraft seat parachute container (13) is located near the top of the main beam assembly. The parachute consists of a 22-inch controller drogue, a 5-foot stabilizing main drogue, and a 17-foot personnel parachute. The controller drogue deploys the stabilizing drogue that decelerates and stabilizes the ejection seat during the initial phase of the ejection sequence. The personnel parachute provides the pilot with a safe means of descent. The parachute container provides support for the pilot's head during forward acceleration or wind blast.

The personnel parachute is packed in the container first. It is secured by flaps and a closure pin that is attached to the personnel parachute withdrawal line. The withdrawal line attaches the main drogue to the apex of the personnel parachute. Then the main and controller drogues are packed. They are secured by four flaps and a closure pin, which is attached to the drogue withdrawal line. The drogue shackle secures the parachute withdrawal line and extender strap. Then the drogue shackle is secured in the scissor mechanism.

Seat Bucket

The seat bucket (14) is mounted on the lower forward side of the main beam assembly. It is attached to studs on the seat bucket runners. The components described in the following paragraphs are related to the seat bucket.

EJECTION CONTROL HANDLE.—The ejection control handle (16) is located on the front of the seat pan. It is the only means by which ejection can be initiated. The handle is molded in the shape of a loop and is connected to the sears of the ejection seat initiators. The seat initiators have two rigid lines that connect to the trombone fittings. An upward pull of the loop removes both sears from the dual initiators to initiate ejection. Either initiator can fire the seat. After ejection, the handle remains attached to the seat. The ejection control handle is safetied by using the ejection seat safe/arm handle and safety pin.

EJECTION SEAT SAFE/ARM HANDLE.—To prevent inadvertent seat ejection, an ejection seat safe/arm handle (18) is installed. To safety the seat, you must rotate the handle up and forward. To arm the seat, you rotate the handle down and aft. When in the ARMED position, the portion of the handle that is visible to the pilot is colored yellow and black with the word ARMED showing. In the SAFE position, the visible portion of the handle is colored white with the word SAFE showing. By placing the handle to the SAFE position, it causes a pin to be inserted into the ejection firing mechanism. This prevents withdrawal of the sears from the dual seat initiators.

SHOULDER HARNESS CONTROL HANDLE.—The shoulder harness control handle (11) and seat height adjustment switch (10) are mounted on the left side of the seat bucket. The shoulder harness control handle is connected to the inertia reel. The seat height adjustment switch controls electrical power to the seat height actuator motor.

MANUAL OVERRIDE HANDLE.—The manual override handle (17) is located on the right side of the seat bucket. The handle is connected to the lower restraint mechanism. It is also connected to the manual override initiator (19).

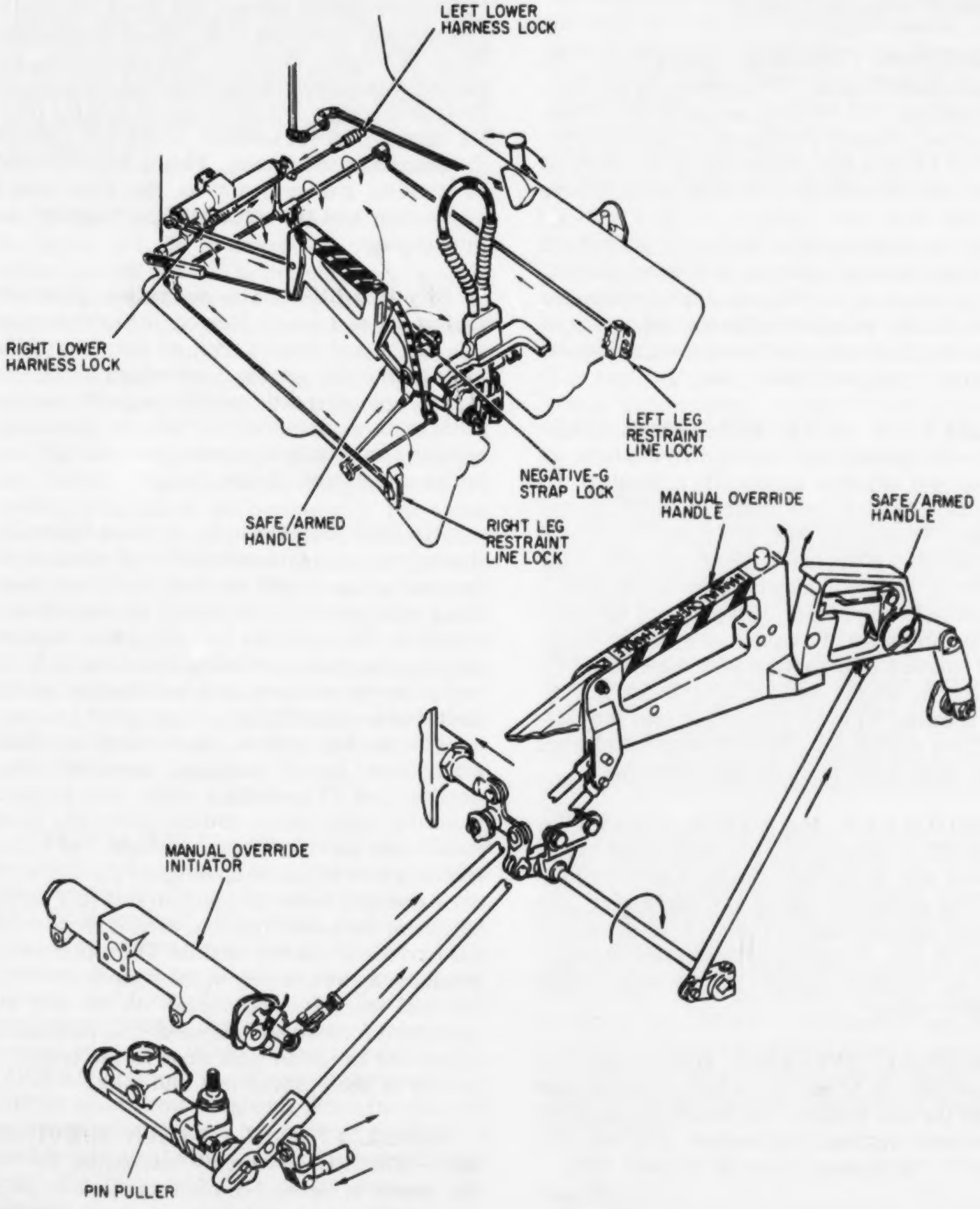
MANUAL OVERRIDE INITIATOR.—The manual override initiator, shown in figure 2-4, is mounted in a covered compartment in the lower aft right side of the seat bucket. A linkage connects the sear to the manual override handle. Pulling the handle releases the lower restraints. Full upward movement of the handle is prevented by the pin puller. However, during ejection, the pin puller is automatically retracted. This allows the manual override handle to pull the sear from the manual override initiator, which will override the automatic sequencing. This is accomplished by routing gas pressure to the time-release mechanism and the secondary cartridge of the drogue gun.

PIN PULLER.—The pin puller, shown in figures 2-1 and 2-4, is located on the rear right side of the seat bucket. Full aft rotation of the manual override handle is prevented by the pin puller. A pin extended from the pin puller engages a slot in the manual override linkage. During the ejection sequence, gas pressure from the right seat initiator cartridge retracts the pin.

ROCKET MOTOR.—As shown in figure 2-1, the rocket motor (8) is attached to the bottom of the seat bucket. A rigid line from the rocket motor firing mechanism is connected to the inboard trombone fitting on the rear left side of the seat bucket. The trombone fitting interfaces with the rocket motor initiator, which is located on the main beam assembly.

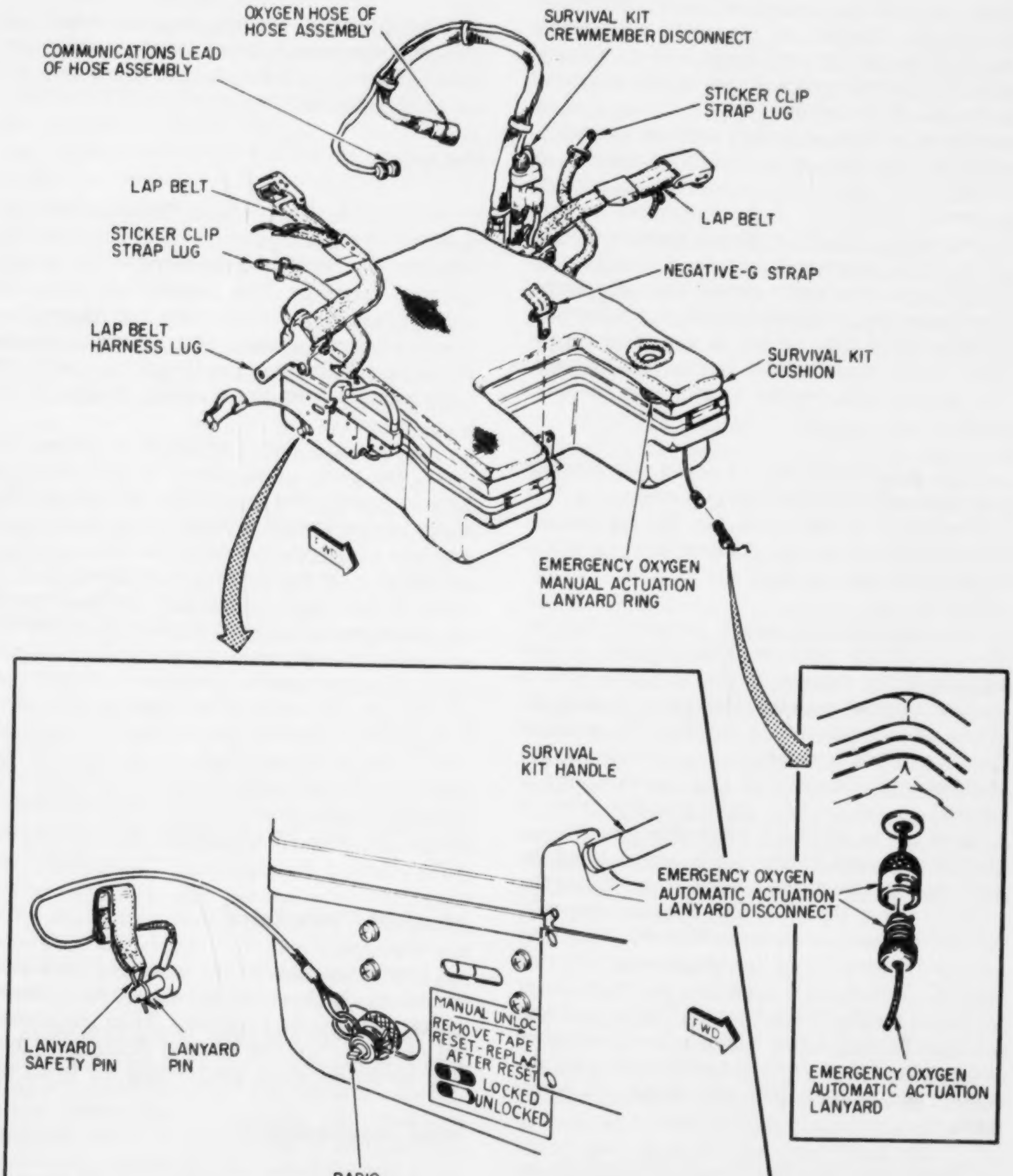
The rocket motor consists of a firing mechanism, igniter cartridge, manifold, four nozzles, and 17 propellant tubes. Gas pressure from the rocket motor initiator forces the firing mechanism into the igniter cartridge. The rocket motor ignites as the catapult nears the end of its extension and raises the ejection seat to a height sufficient for a safe ejection, even if the aircraft has zero speed and zero altitude. The rocket motor produces approximately 4,500 pounds of thrust for 0.25 seconds. The nozzles on the seat are positioned forward and outward. This positioning allows the thrust to pass close to the center of gravity of the ejection seat and pilot.

AIRCRAFT SEAT OXYGEN SURVIVAL KIT.—The SKU-3/A aircraft seat oxygen survival kit, shown in figure 2-5, consists of a two-piece bonded fiberglass container and a seat cushion. The kit is located in the seat bucket and functions as a seating platform for the pilot. The survival kit also contains the torso harness attachments,


LEFT LOWER HARNESS LOCK
RIGHT LOWER HARNESS LOCK
LEFT LEG RESTRAINT LINE LOCK
NEGATIVE-G STRAP LOCK
SAFE/ARMED HANDLE
RIGHT LEG RESTRAINT LINE LOCK
MANUAL OVERRIDE HANDLE
SAFE/ARMED HANDLE
MANUAL OVERRIDE INITIATOR
PIN PULLER

214.206

Figure 2-4.—Manual override system.


OXYGEN HOSE OF
HOSE ASSEMBLY
SURVIVAL KIT
CREWMEMBER DISCONNECT
COMMUNICATIONS LEAD
OF HOSE ASSEMBLY
STICKER CLIP
STRAP LUG
LAP BELT
LAP BELT
STICKER CLIP
STRAP LUG
NEGATIVE-G STRAP
LAP BELT
HARNESS LUG
SURVIVAL KIT
CUSHION
FWD
EMERGENCY OXYGEN
MANUAL ACTUATION
LANYARD RING
SURVIVAL
KIT HANDLE
EMERGENCY OXYGEN
AUTOMATIC ACTUATION
LANYARD DISCONNECT
MANUAL UNLOC
REMOVE TAPE
RESET-REPLAC
AFTER RESET
LOCKED
UNLOCKED
FWD
LANYARD
SAFETY PIN
LANYARD
PIN
RADIO
BEACON
EMERGENCY OXYGEN
AUTOMATIC ACTUATION
LANYARD

214.207

Figure 2-5.—SKU-3/A survival kit.

locking system, retaining lanyard, survival equipment, radio beacon, and emergency oxygen. A bracket for insertion of the negative-g strap is mounted on the forward lower half of the survival kit. The emergency oxygen system is located in the lid of the survival kit. It consists of an emergency oxygen cylinder, reducer assembly, actuation assembly, and manifold assembly. A lanyard and quick-disconnect fitting provide automatic actuation of the emergency oxygen system during ejection. If the aircraft oxygen system fails, emergency oxygen is available by actuating the emergency oxygen manual release. The release is a green ring located on the forward left side of the survival kit. A mounting is provided for the radio locator beacon and lanyard. The lanyard actuates the locator beacon upon ejection.

LEG RESTRAINTS.—Two leg restraint line snubbing units and lines are mounted to the forward structure of the seat bucket. The leg restraint lines are secured in locks located on the inboard sides of the seat bucket.

The leg restraints secure the pilot's legs to the seat during ejection. They consist of two adjustable leg garters, a restraint line, and a snubber unit for each leg. One garter is worn on the thigh and one on the lower leg. The restraint lines are routed through the garter rings and the snubber unit. One end of each restraint line is secured to the cockpit floor and the other is secured to the seat by a releasable pin. During ejection, the slack in each line is taken up and the leg lines separate at the tension rings. When the pilot and seat separate, the pins are normally released by the time-release mechanism. They may also be released by pulling the manual override handle. Both the lower garter and thigh garter contain a quick-release buckle. The leg restraint line runs through a ring which is disconnected by the buckle. This permits the pilot to exit the aircraft while wearing both the upper and lower garters.

The lower restraint mechanism locks are located in the lower aft portion of the seat bucket. These locks are connected by a cross shaft and linkage to the leg restraint line locks and the negative-g strap lock.

COMPONENT OPERATION

The operation of each component and subsystem is discussed in the following paragraphs. The operation of the system as a whole is discussed later in the chapter.

Catapult

A firing pin in the catapult firing mechanism is actuated by ballistic gas from the 0.3-second delay initiator. The firing pin then strikes the catapult primary cartridge. The ballistic gas from the primary cartridge starts the inner and intermediate barrels to extend upward. The upward movement of the inner barrel releases the spring-loaded top latch plunger from the retaining groove on the inner barrel.

As the inner barrel continues to extend upward, the ports of the inner and intermediate barrels expose the secondary cartridges. The secondary cartridges are ignited by the pressure and heat of the primary cartridge. The secondary cartridges assist in propelling both barrels and seat upward. After approximately 37 inches of travel, the piston head on the intermediate barrel contacts the pressure rings. These rings absorb the inertia force. The inner barrel continues to extend until it contacts the inner guide bushing. The inner barrel shears the rivet connecting the inner guide bushing to the intermediate barrel. This shearing separates the inner and intermediate barrels. The intermediate and outer barrels remain with the aircraft. The inner barrel remains with the ejection seat.

Manifold Check Valve

Gas from the delay initiators enters the manifold check valve and causes two internal check valves to be depressed. Then gas pressure passes to the catapult primary firing mechanism and severs the shear pin holding the firing pin.

Main Beam Assembly

The main beam assembly supports the major components of the ejection seat. The operation of the components supported by the main beam assembly is discussed in the following paragraphs.

TOP LATCH MECHANISM.—When the ejection seat is installed on the catapult, the top latch handwheel is removed. The top latch mechanism plunger passes through a hole in the outer barrel of the catapult and engages the locking groove. A locked indication is given by the position of the plunger and the indicator within the top latch mechanism housing. When the locking indicator spring-loaded plunger and mechanism housing are flush with each other, the top latch mechanism is locked. To remove the seat, you must install the top latch handwheel on the top latch plunger. This releases the seat from the catapult gun.

DROGUE GUN.—As the ejection seat rises, the trip rod withdraws the firing link from the drogue gun firing mechanism. This releases the spring-loaded firing pin. Firing pin movement is slowed for 0.5 second by an escapement mechanism to allow the ejection seat to clear the aircraft. After a 0.5-second delay, the firing pin activates the primary cartridge. Heat and pressure from the primary cartridge cause the secondary cartridge to fire. The gas produced by both cartridges shears the shear pin and expels the piston from the drogue gun barrel.

The drogue withdrawal line is attached to the piston. When expelled, the piston withdraws the pin from the closure flaps of the parachute container and deploys the drogue parachutes. The secondary cartridge serves as a back-up system to the mechanically fired primary system. The cartridges in the time-release mechanism and manual override initiator provide gas pressure to the gas-operated secondary firing mechanism of the drogue gun. If the drogue gun primary firing mechanism fails, the gas-operated secondary firing mechanism cartridge will be fired by the secondary cartridge and the combined gas pressure will expel the piston from the drogue gun barrel to deploy the drogue parachutes.

TIME-RELEASE MECHANISM.—As the ejection seat rises, the trip rod also withdraws the firing link from the TRM and releases a spring-loaded firing pin. Firing pin movement is prevented for 1.5 seconds by a barostat and g-controller. When the altitude of the seat is less than 14,500 feet and acceleration forces are less than 3 g's, the barostat and g-controller release the firing mechanism. After the 1.5-second delay, the firing pin activates the cartridge. The gas produced by the cartridge passes to the upper body chamber and forces the shackle plunger down. This allows the scissor mechanism to open. At the same time, the gas actuates the connecting rod in the lower body and opens the inertia reel locks. Gas pressure is also provided to operate the piston to release the personnel parachute, manual override initiator, and the drogue gun secondary cartridge.

SCISSOR MECHANISM.—When the TRM cartridge fires, the shackle plunger retracts into the upper body of the TRM. This action allows the movable jaw of the scissor mechanism to open and release the personnel parachute from the container.

INERTIA REEL.—During the ejection sequence, gas pressure is used to fire the inertia reel cartridge. The gas pressure forces the head of the piston along the cylinder. The horizontal movement of the piston is transmitted by a threaded drive screw to rotate the ratchet wheel. The rotation of the ratchet wheel retracts the inertia reel straps and restrains the pilot in the seat. Then the locking pawl locks the spools in the retracted position.

Extension of the inertia reel straps at excessive speed causes the governor pawls to rotate outward because of centrifugal force. They engage the rack on the housing which prevents any additional extension of the straps. When the shoulder harness control handle is in the rear position, the system restrains the pilot from moving forward. With no tension applied to the inertia reel straps, the pawl will reset itself and disengage from the rack. This will allow free extension of the straps.

ROCKET MOTOR INITIATOR.—During the ejection sequence, the static line connected to the drogue gun trip rod and to the rocket motor initiator is withdrawn from the aft initiator housing. When the static line is extended to approximately 72 inches, a spring-loaded plunger is unlocked. The plunger rotates the quadrant lever and removes the sear from the firing mechanism. Removal of the sear fires the cartridge in the breech. The gas produced is routed to the rocket motor firing mechanism, which ignites the rocket motor.

AIRCRAFT SEAT PARACHUTE.—The drogue shackle, which contains the parachute withdrawal line and extender strap, allows the drogues to be deployed without extraction of the personnel parachute. A mechanical lock secures the parachute withdrawal line to prevent premature deployment until pilot and seat separation has occurred. The lock is released by a piston in the upper body of the time-release mechanism.

The parachute risers are routed down the forward side of the parachute container. Quick-release fittings are located on the end of the risers and connect to the pilot's torso harness. The inertia reel straps are routed from the inertia reel, through the parachute riser roller fittings, and are secured in the inertia reel locks.

Seat Bucket

The seat bucket supports several components on the lower portion of the ejection seat. The operation of these components is discussed in the following paragraphs.

EJECTION SEAT INITIATOR.—With the safe and arm handle in the down or ARMED position, an upward pull on the ejection control handle removes the two sears from the firing mechanisms and causes the two cartridges within the initiator to fire. Gas pressure from either cartridge will initiate seat ejection.

MANUAL OVERRIDE INITIATOR.—Aft rotation of the manual override handle positions the safe and arm handle up to the SAFE position and releases the lower restraint. In this position, the pin puller engages a slot in the manual override handle linkage and prevents actuation of the manual override initiator. During the ejection sequence, the pin puller is retracted inboard. This allows the manual override initiator to be actuated and override the automatic sequencing. Gas pressure from the manual override initiator is piped to the time-release mechanism and the secondary cartridge in the drogue gun.

PIN PULLER.—During the ejection sequence, gas pressure from the right seat initiator cartridge enters the pin puller and operates a spring-loaded ball lock. This allows the pressure to retract the pin and disengage it from the manual override linkage.

AIRCRAFT SEAT OXYGEN SURVIVAL KIT.—The survival kit is opened by operating the release handle located on the right forward side of the kit. During the ejection sequence, the oxygen hose and communication lead disconnect from the aircraft. The emergency oxygen and radio beacon are automatically actuated. During parachute descent, the pilot may operate the release handle to open the survival kit. This allows deployment and inflation of the life raft. The life raft and survival equipment are connected by a lanyard to the survival kit lid, which is attached to the pilot.

MANUAL OVERRIDE SYSTEM.—Operation of the manual override handle will rotate the cross shaft of the lower harness locks, leg restraint line locks, and the negative-g strap lock. This is necessary for emergency ground egress from the aircraft. Full aft rotation of the handle is prevented by engagement of the pin puller piston in a slot of the manual override handle linkage. This prevents firing of the manual override initiator.

During the ejection sequence, gas pressure from the right seat initiator cartridge operates the pin puller to withdraw the pin puller piston from the slot in the manual override handle linkage. In the event of a time release mechanism failure or drogue gun failure above barostatic altitude, aft rotation of the manual override handle will fire the manual override initiator. Gas pressure from the manual override initiator cartridge operates the lower harness release system. It will also pass up the trombone fitting and fire the time-release mechanism cartridge. This cartridge operates the upper harness release mechanism, scissor mechanism release plunger, and parachute lock. Additionally, the gas pressure passes to the drogue gun and fires the secondary cartridge.

LEG RESTRAINT SYSTEM.—As the seat travels up the guide rails during the ejection sequence, the leg restraint lines are drawn through the snubbing units. This action pulls the pilot's legs aft against the seat bucket. As the seat continues to rise, the leg restraint lines become taut. When the force on the bottom fittings reaches approximately 900 pounds, the shear ring will shear. The shearing releases the lower portion of the leg restraint lines.

Automatic Harness Release System

Firing of the time-release mechanism cartridge moves the piston and connecting rod down and rotates the cross shaft. Rotation of the cross shaft releases the inertia reel locking plungers and releases the inertia reel straps. Simultaneously, gas pressure is routed down the trombone fitting to fire the cartridge in the manual override initiator. Gas pressure from the manual override initiator cartridge presses against the head of the piston. Movement of the piston rotates the bell crank lever and releases the spring-loaded locking plungers of the lower harness locks. This releases the lap belt lugs and rotates the cross shaft. Rotation of the cross shaft releases the locking plungers in the leg restraint line and negative-g strap locks.

SYSTEM OPERATION

Before flight, the ejection seat safe/arm handle is kept in the SAFE position. In this position, the visible portion of the handle is colored white and placarded as SAFE. When the aircraft is ready for flight, the pilot sets the safe and arm handle to the ARMED position. In this position, the visible portion of the handle is colored with yellow and black markings and placarded as ARMED.

The ejection sequence, shown in figure 2-6, (a foldout at the end of the chapter) starts when the pilot pulls the ejection control handle. The upward movement of the handle removes two sears from the seat initiator and fires two cartridges with the seat initiator.

Firing Sequence

Ballistic gas generated by the right cartridge within the seat initiator actuates the pin puller. The gas also activates the shielded mild detonating cord (SMDC) initiator. The SMDC then activates the aircraft identification friend or foe unit (IFF) and the canopy jettison system. Additionally, it activates the inertia reel cartridge and the 0.3-second delay initiator. Ballistic gas generated by the left cartridge within the seat initiator starts the 0.3-second delay initiator. Ballistic gas pressure from either 0.3-second delay initiators ignites the primary cartridge within the catapult.

Catapult Firing and Initial Seat Movement

Ballistic gas pressure developed by the catapult primary cartridge causes the inner and intermediate barrels within the catapult to rise and release the top latch mechanism. The secondary cartridges within the catapult fire progressively as the rising barrels are exposed to the heat and pressure of the primary cartridge gas. Progressive firing of the catapult secondary cartridges provides a relatively even gas pressure during catapult extension. This eliminates excessive g-forces during ejection.

As the seat moves upward, the emergency oxygen system is activated. A trip rod withdraws the firing link from the drogue gun and starts a 0.5-second internal timer. Another trip rod withdraws the firing link from the time release mechanism. Aircraft electrical power and personal services (oxygen and communication) between the seat and the aircraft are disconnected.

At this point in the sequence, the leg restraint lines are drawn through the snubbing units to restrain the pilot's legs to the seat bucket. When the leg restraint lines becomes taut, the upper portion of the leg restraint line shears from the lower portion, which is attached to the floor bracket. Forward movement of the lines is prevented by the snubbing units.

After 72 inches of catapult extension, the rocket motor initiator is fired by a cable that is attached to the drogue gun trip rod. Ballistic gas pressure generated by the cartridge within the rocket motor initiator is routed to a pressure actuated firing mechanism located on the rocket motor. Flame and pressure ignite the rocket motor propellant grain. The thrust of the motor is approximately 4,500 pounds and lasts for 0.25 seconds.

Aircraft and Seat Separation

Separation of the seat from the aircraft occurs at approximately 76 inches of catapult extension. At this point, the inner barrel separates from the intermediate barrel. The seat is now clear of the aircraft.

The drogue gun primary cartridge fires after a 0.5-second delay to propel the piston from the drogue gun barrel. The inertia of the piston extracts the parachute flap closure pin and deploys the 22-inch controller drogue. The controller drogue in turn deploys the 60-inch stabilization and retardation drogue. The 0.5-second time delay allows the seat to reach its maximum altitude before the drogues are fully developed. The seat will stabilize and decelerate because of the drogues, which are held to the seat by the scissor mechanism.

If the drogue gun primary cartridge fails to fire, ballistic gas pressure will pass to the drogue gun when the TRM fires. This gas shears the firing pin retaining pin. The firing pin then strikes the secondary drogue gun cartridge, which results in drogue deployment. Should both the drogue gun primary and time-release mechanism cartridges fail to fire, operation of the manual override handle will fire the manual override initiator cartridge. This duplicates the function of the TRM and fires the drogue gun secondary cartridge. The drogue gun then deploys the drogue parachutes and personnel parachute concurrently.

The TRM altitude-sensing barostatic time release prevents the 1.5-second timer from starting at altitudes above 11,500 feet. The barostatic time release ensures that the pilot descends rapidly through the upper atmosphere to a more survivable altitude. At altitudes between 7,500 and 11,500 feet, the time delay for deployment of the personnel parachute is controlled by an internal g-limiter, which interrupts the timing sequence until the deceleration force is less than 1.5 g's. This results in lower parachute opening loads. At altitudes below 7,500 feet, the 1.5-second timer starts without interruption.

After the 1.5-second timer delay, the TRM cartridge fires. This releases the upper restraint mechanism, lower restraint mechanism, parachute mechanical lock, and drogue shackle. When the drogue is free from the scissor mechanism, it deploys the personnel parachute. The personnel parachute lifts the pilot and the survival kit from the seat and pulls the sticker-clip strap lugs from their clips. This is necessary to ensure that collision between the seat and the pilot is avoided. The radio beacon activates when pilot and seat separation occurs. Then a normal parachute descent begins.

While descending in the parachute, the pilot can actuate the survival kit handle to separate the kit halves. This allows deployment and automatic inflation of the life raft. The life raft and survival kit items are connected by a lanyard to the survival kit lid, which is attached to the pilot.

COMPONENT TEST AND TEST EQUIPMENT

Ejection seats and associated components are carefully designated, manufactured, and tested to ensure dependable operation. Such equipment must function perfectly the first time it is used. Malfunction or failure to operate usually results in severe injury or death to crew members. You must use the utmost care in maintaining escape system equipment. Proper handling and strict compliance with the maintenance procedures presented in the maintenance instructions manuals (MIMs) and the maintenance requirements cards (MRCs) are mandatory and cannot be overemphasized.

NOTE: The information presented in this chapter must not be used in place of information provided in the MIM.

The SJU-5/A ejection seat undergoes a variety of functional checks during the 364-day special inspection. Indepth testing of the firing unit mechanisms, catapult gun, time-release mechanism, drogue gun, and a complete mechanical operational check is required. The time-release mechanism and drogue gun checks are discussed in the following paragraphs.

Drogue Gun Check-out

The drogue gun must be removed from the ejection seat to accomplish the check-out. You should make sure the drogue gun is disarmed before performing any maintenance on it. Then, you should remove the drogue gun barrel and piston and inspect them for damage and corrosion. The three tests used in the check-out are the time delay test, the firing pin protrusion test, and the firing pin cocking test. These tests must be done with the barrel and piston removed. These tests are discussed in the following paragraphs.

TIME DELAY TEST.—To complete the time delay test, you should perform the following steps in sequence.

1. Install the drogue gun adapter on the time delay test base. Connect the adapter electrical cables to the time delay test set timer. Then connect the test set to a 110-volt ac 60-Hz power supply. An air source regulated to 80 psi is also required. Figure 2-7 reflects the correct mounting of the drogue gun to the test set.

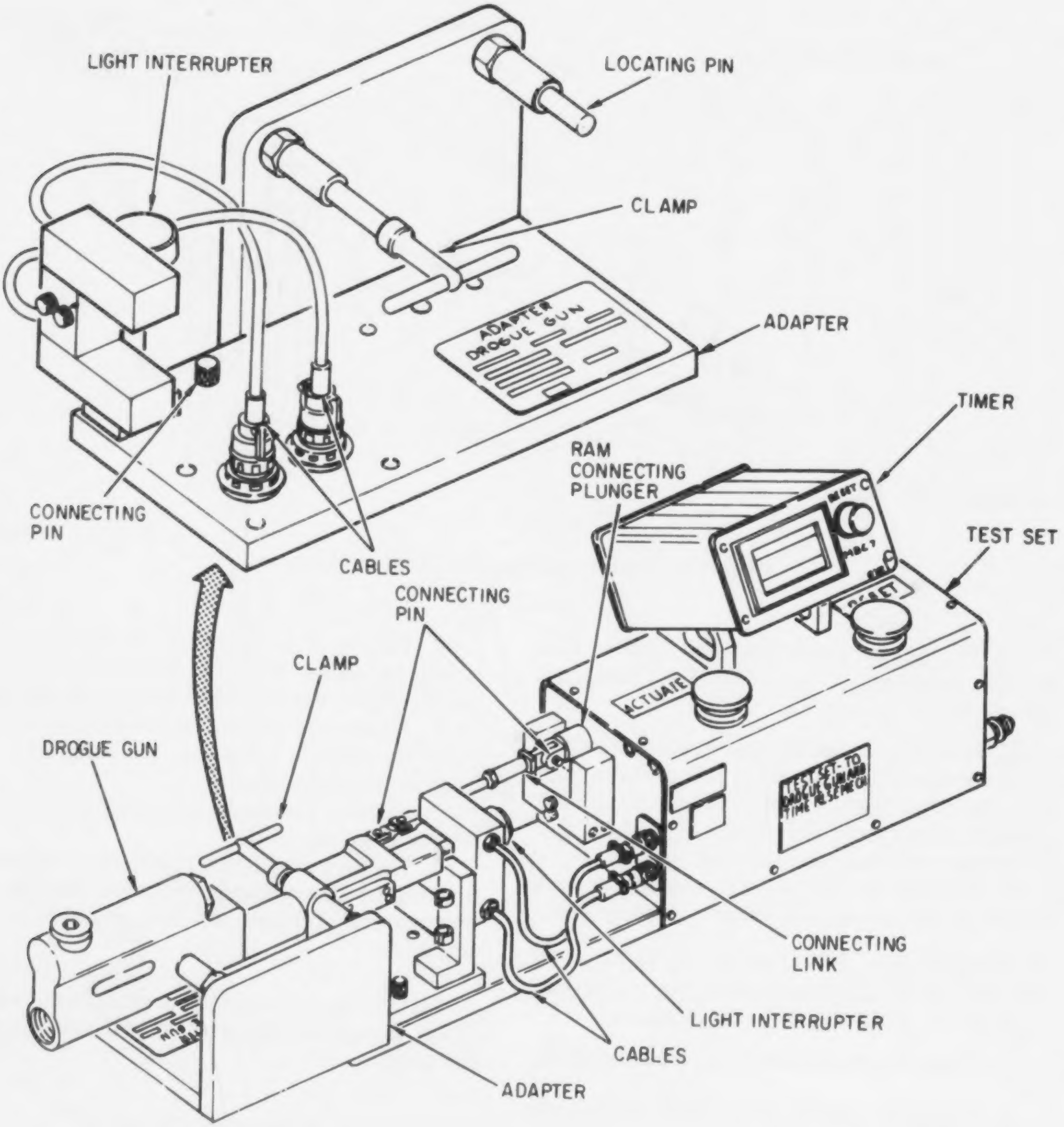

LIGHT INTERRUPTER
LOCATING PIN
CLAMP
ADAPTER
ADAPTER
DROGUE GUN
TIMER
RAM
CONNECTING
PLUNGER
TEST SET
CONNECTING
PIN
CABLES
CONNECTING
PIN
RESET
RESET
ACTUATE
TEST SET- TO
CLAMP
DROGUE GUN
CONNECTING
LINK
LIGHT INTERRUPTER
CABLES
ADAPTER

Figure 2-7.—Drogue gun time delay check-out.

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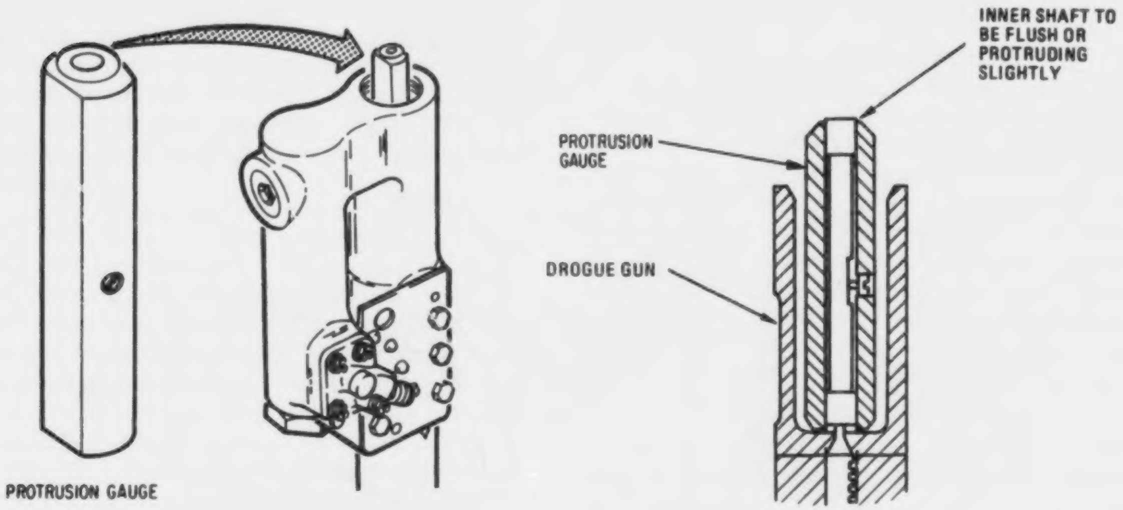
2. Extend the ram connecting plunger by pressing the reset button on the test set. The reset button also sets the timer to zero. Remove the lockwire from the drogue gun firing link and remove the hex head plug from the base of the drogue gun. Ensure the drogue gun is secured to the test set with the clamp. Next, attach the drogue gun firing link to the test set connecting ram plunger with the connecting link and connecting pins. Install the light interrupter into the base of the drogue gun.



214.210

Figure 2-8.—Drogue gun firing pin protrusion check-out.

NOTE: Before proceeding any further with the test, ensure quality assurance (QA) personnel are present to witness the results.

3. Press the time delay test set actuate button and record the time required to pull the firing link from the drogue gun. The elapsed time should not exceed 0.5 ± 0.1 second. If the test is unsuccessful, the drogue gun must be replaced.
4. Remove the light interrupter and drogue gun from the test set and secure the equipment.

FIRING PIN PROTRUSION TEST.—To complete the firing pin protrusion test, you should perform the following steps in sequence.

1. Place the protrusion gage over the firing pin.
2. Check the position of the inner center shaft of the gage. It must be flush or slightly above the gage outer case, as shown in figure 2-8.
3. If the firing pin fails this test, the drogue gun must be replaced.

FIRING PIN COCKING TEST.—To complete the firing pin cocking test, you should perform the following steps in sequence.

1. Place the drogue gun clamp into a vise and position the drogue gun on the clamp. Screw the cocking handle into the base of the drogue gun.
2. Pull the handle until the firing mechanism is fully extended. With the mechanism fully extended, install the firing link into the drogue gun.
3. Release the tension on the cocking handle. If the mechanism is cocked, the firing link will be held firmly in place.
4. Remove the handle and install the hex head plug and washer.
5. Lockwire the firing link to the drogue gun housing by inserting the lockwire through the housing and roll pin, which is attached to the firing link.

NOTE: At this point in the procedure, request QA to inspect the engagement and lockwiring of the sear.

Time-Release Mechanism Check-out

The time-release mechanism must be removed from the ejection seat to accomplish this check-out. You should ensure the TRM is disarmed before performing maintenance on it. Then, remove the firing body from the time-delay g-sensing release mechanism. Then remove the lockwire from the firing link and remove the hex head plug and washer from the base of the unit. Inspect the TRM for damage and corrosion.

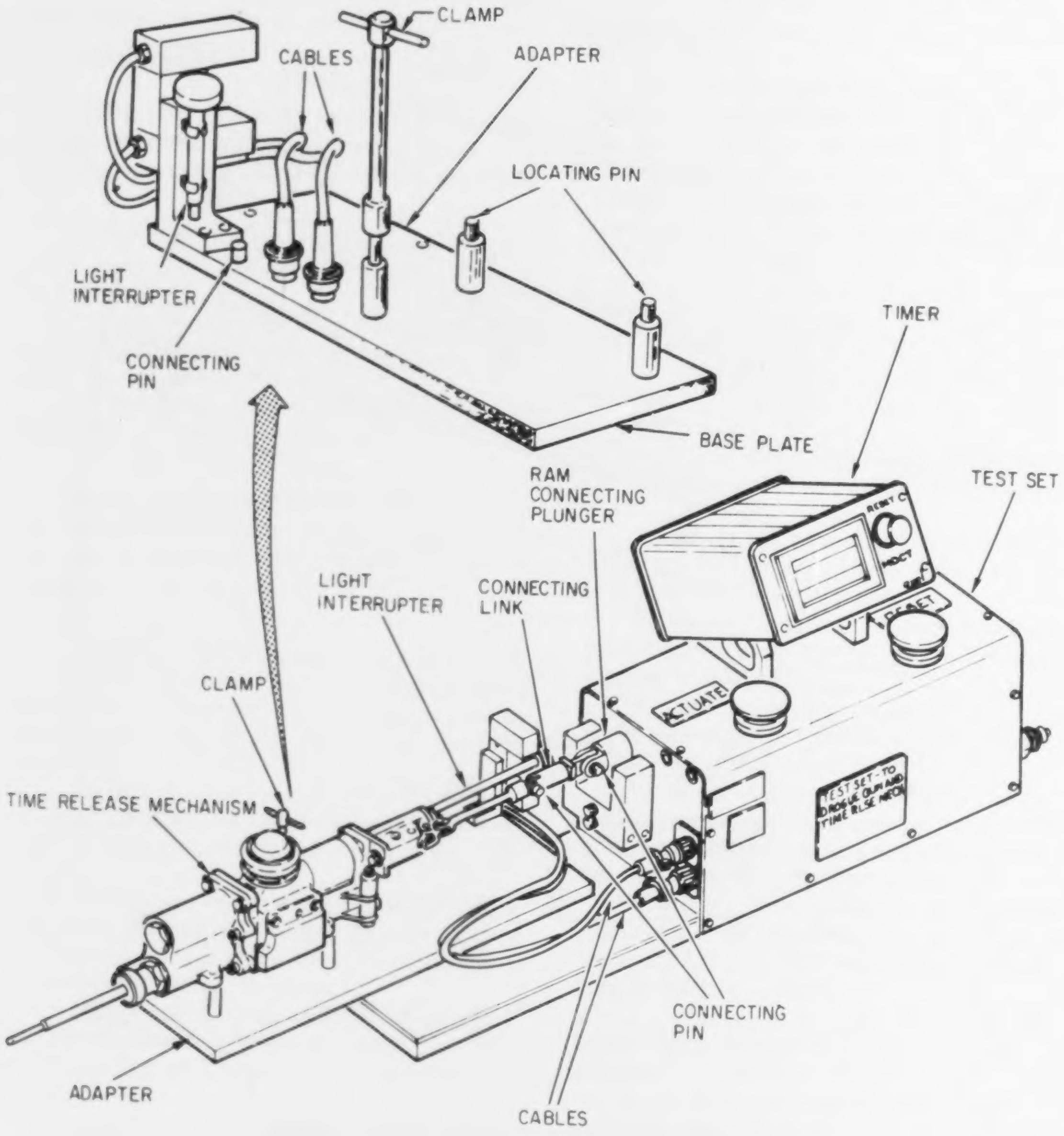

CLAMP
CABLES
ADAPTER
LOCATING PIN
LIGHT INTERRUPTER
CONNECTING PIN
TIMER
BASE PLATE
RAM CONNECTING PLUNGER
TEST SET
RESET
ACTUATE
LIGHT INTERRUPTER
CONNECTING LINK
CLAMP
TEST SET-TO DROGUE GUN AND TIME RLSE MECH
TIME RELEASE MECHANISM
CONNECTING PIN
ADAPTER
CABLES

Figure 2-9.—Time release mechanism time delay check-out. 214.211

TIME DELAY CHECK-OUT.—To complete the time delay check-out, you should perform the following steps in sequence.

1. Remove the light interrupter from the test set and screw it into the base of the time delay g-sensing release mechanism, as shown in figure 2-9. Install the TRM adapter on the time-delay test set base. Connect the adapter electrical cables to the time-delay set timer. Then connect the test set to a 110-volt ac 60-Hz power supply. Again, you will need an air source regulated to 80 psi.

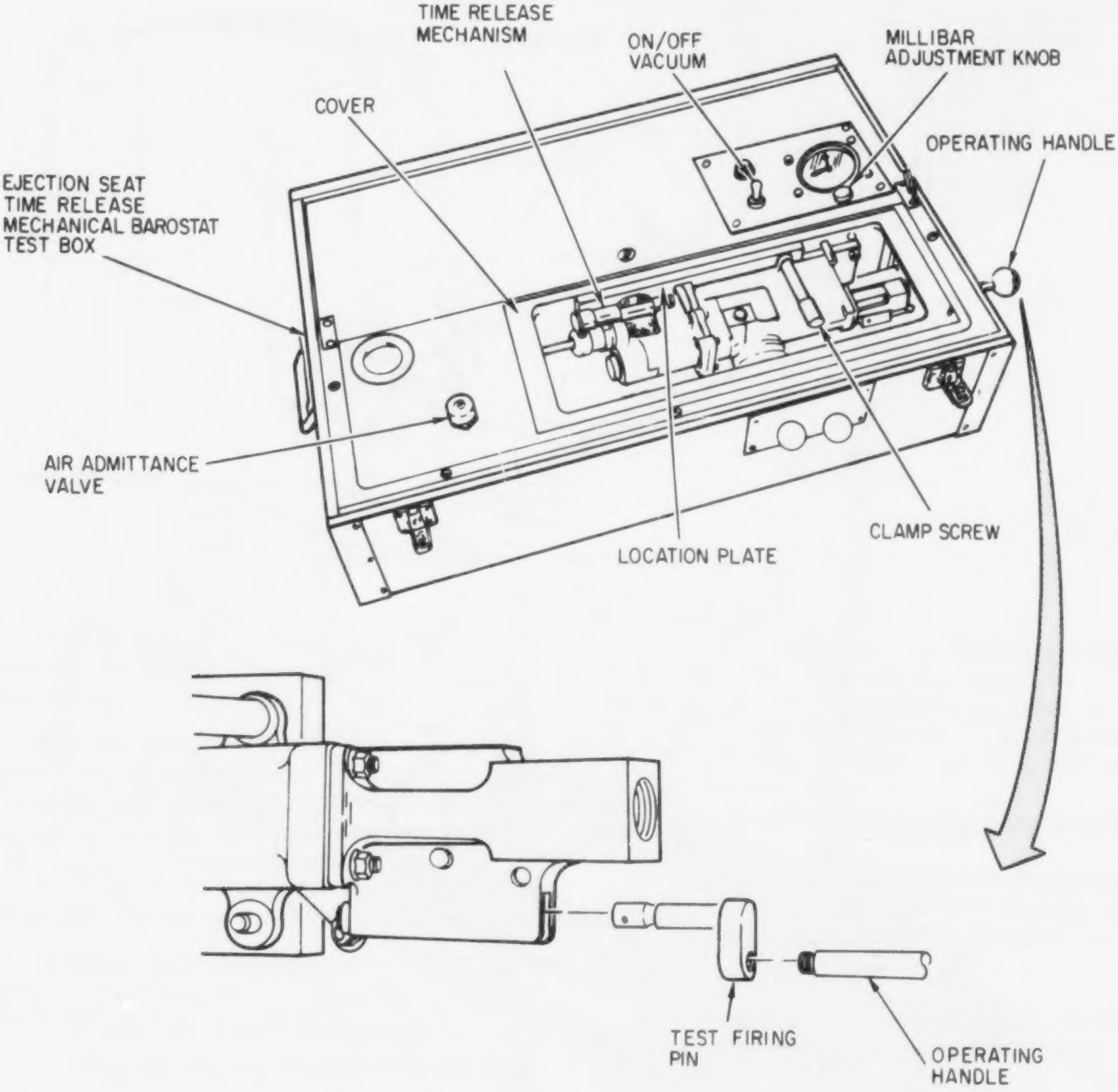

TIME RELEASE MECHANISM
ON/OFF VACUUM
MILLIBAR ADJUSTMENT KNOB
COVER
OPERATING HANDLE
EJECTION SEAT TIME RELEASE MECHANICAL BAROSTAT TEST BOX
AIR ADMITTANCE VALVE
CLAMP SCREW
LOCATION PLATE
TEST FIRING PIN
OPERATING HANDLE

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Figure 2-10.—Time release mechanism barostat check-out.

2. Extend the ram connecting plunger on the test set by pressing the reset button. Position the TRM on the test set and secure it with a test set clamp. Attach the time-delay g-sensing release mechanism firing link to the test set ram connecting plunger, connecting link, and connecting pins.

NOTE: At this point, you should ensure QA personnel are present to witness the elapsed time function.

3. Press the time-delay test set actuate button and record the time required to pull the firing link

from the time-release g-sensing release mechanism. The elapsed time should not exceed 1.5 ± 0.1 seconds.

FIRING PIN PROTRUSION CHECK.—To complete the firing pin protrusion check, you should perform the following steps in sequence.

1. With the cartridge body removed from the TRM, place the TRM protrusion gage over the firing pin.
2. Check the position of the inner center shaft of the gage. It must be flush or slightly above the outer case of the gage.
3. If the firing pin fails this test, it must be replaced.

FIRING MECHANISM COCKING TEST.—To complete the firing mechanism cocking test, you should perform the following steps in sequence.

1. Place the TRM clamp in a vise and position the TRM on the clamp. Screw the TRM cocking handle into the base of the TRM. Pull the cocking handle until the firing mechanism is fully extended.
2. In this position, install the test firing pin into the time-delay g-sensing release mechanism. The test firing pin is furnished as part of the TRM test set.
3. Release the tension on the cocking handle. Ensure the mechanism is cocked by pulling on the test firing pin. If the firing mechanism is cocked, it will be held firmly in place.
4. Remove the cocking handle from the TRM. Then remove the TRM from the clamp. The TRM is now cocked and ready for the barostat test.

BAROSTAT CHECK-OUT.—To complete the barostat check-out, you should perform the following steps in sequence.

1. Connect the TRM test box to a 110-volt ac 60-Hz power supply. Ensure all protective plugs and parts of the test set are installed in the test box holes labeled "cocking control and altitude."
2. Position the TRM in the test set and secure it with a clamp screw as shown in figure 2-10.
3. Insert the operating handle through the hole in the test set labeled "firing control." Screw the handle into the test firing pin.
4. Next, set the test box altimeter to 1013 millibars. With this setting, the altimeter will show a reading in feet above sea level and the altitude test will be relative to sea level.
5. Ensure the test set cover and seal are clean before closing the cover. A light application of pressure might be required to seal the cover.
6. Turn the vacuum release valve clockwise to the CLOSED position.

NOTE: Before you continue with the test, QA personnel should be present to witness the results.

7. Set the test set switch to the ON position. Make sure the vacuum pump starts and the red indicator light is illuminated.
8. While you monitor the test set altimeter, set the on/off switch to OFF when the altimeter reaches 30,000 feet.
9. Next, pull the operating handle to remove the test set firing pin from the TRM. The TRM should not operate at this time.
10. Monitor the test set altimeter while you slowly open the vacuum release valve. Open it until the altimeter indicates a steady descent rate, but not exceeding 200 feet per second.
11. Record the reading on the altimeter at which the TRM actuates. The actuation must occur at 13,000 ± 1,500 feet. If the TRM fails the test, it must be replaced.
12. After actuation, open the test set vacuum release valve. When the altimeter indicates zero, carefully open the test set cover.
13. Remove the clamp and disconnect the test firing pin from the TRM. Then remove the TRM from the test set.
14. Secure the test set and recock the TRM. Lockwire the firing link to the TRM and install the hex head plug and washer in the base of the TRM.

NOTE: QA should inspect the sear installation and lockwire.

Other Tests

Other tests are required for this ejection seat. These tests are performed in strict compliance with the MRCs and MIMs. The steps requiring QA action are also very important.

All ejection seat parts and components received from supply must be checked or tested before being put into service. It is also recommended that ejection seats be installed on their mated ejection catapult guns.

Cannibalization of ejection system components must be held to an absolute minimum. The swapping of components increases the possibility of maintenance error. Minimizing cannibalization should also decrease the possibility of logbook record error.

CORROSION CONTROL

The existing MIMs and MRCs for most ejection seat systems do not provide sufficient or explicit instruction for corrosion control and lubrication. The *Aircraft Weapons System Cleaning and Corrosion Control Manual*, NA 01-1A-509, and COMNAVAIRPAC/COMNAVAIRLANT INSTRUCTION 4750.2 (Series) contain more information on corrosion control. These publications should be on your required reading list. The *Aviation Maintenance Ratings 1 & C*, NAVEDTRA 10343, also contains information regarding corrosion control. If needed, commands may develop local MRCs or local maintenance instructions to help eliminate corrosion of ejection seats.

The following general information pertains to most ejection seats. Steps must be taken to prevent corrosion before it occurs. Correct procedures for repair of components and systems after corrosion has been treated must be used to ensure that corrosion does not return. The performance of the 210- and 364-day inspections, the 7-day inspections while at sea, and the 14-day inspections while ashore should be conducted according to the applicable MIMs and MRCs. Preventive maintenance on seat components, including procedures for cleaning and lubrication, is discussed in the following paragraphs.

SEAT STRUCTURE AND COMPONENTS

Command philosophy varies regarding the painted parts of a seat structure. Some squadrons strip and paint at each 210- and 364-day inspection. Some leave the original anodized finish unpainted. Some touch-up chipped paint. Some do nothing. Each of these philosophies has some merit depending upon local conditions. The seat bucket and beam structure should be wiped with VV-L-800 general purpose oil. You should allow the oil to soak into crevices, around rivets, and then wipe dry.

Clean metal components with P-D-680, Type II dry-cleaning solvent and then inspect them for surface damage and corrosion. Do not attempt to remove light corrosion or discoloration of the cadmium-plated parts. Parts showing rust or pitting of the base metal or more than one area of plating loss should be replaced. Remove light corrosion, except for cadmium plated parts, by using a fine Scotchbrite abrasive mat or 500/600 aluminum oxide abrasive cloth. Lubricate moving parts, such as springs, linkage, and pivot areas, with MIL-G-81322 general purpose grease. Lubricate firing pins and rollers with VV-L-800 oil. When using VV-L-800 oil, you should apply it with a clean, lint-free cloth such as MIL-C-85043.

Indiscriminate use of paint, preservatives, or other materials that dry and buildup following application can prevent or restrict proper motion of movable parts. These materials must only be used where specified on nonmoving parts. Paint touch-ups of seats installed on the aircraft should be accomplished with a brush.

METAL REMOVAL

The following paragraphs provide guidelines for removal of corrosion products without damaging the structure. Removal of corrosion that has propagated beyond these limits requires replacement of the part.

Cadmium-Plated Parts

On cadmium-plated parts, corrosion will be evident as mottling of the plated surface with color ranging from light gray to black. This is a function of the cadmium plating to protect the underlying base metal, and no attempt should be made to remove the discoloration. The presence of exposed base metal in a localized area is acceptable and should be protected. The appearance of red rust is cause for part replacement.

Chromium and Nickel-Plated Parts

You should polish bright plated parts with a fine Scotchbrite abrasive mat or 500/600 aluminum oxide abrasive cloth. Do not penetrate to the base material. If base material is exposed it is cause to remove and replace the affected part.

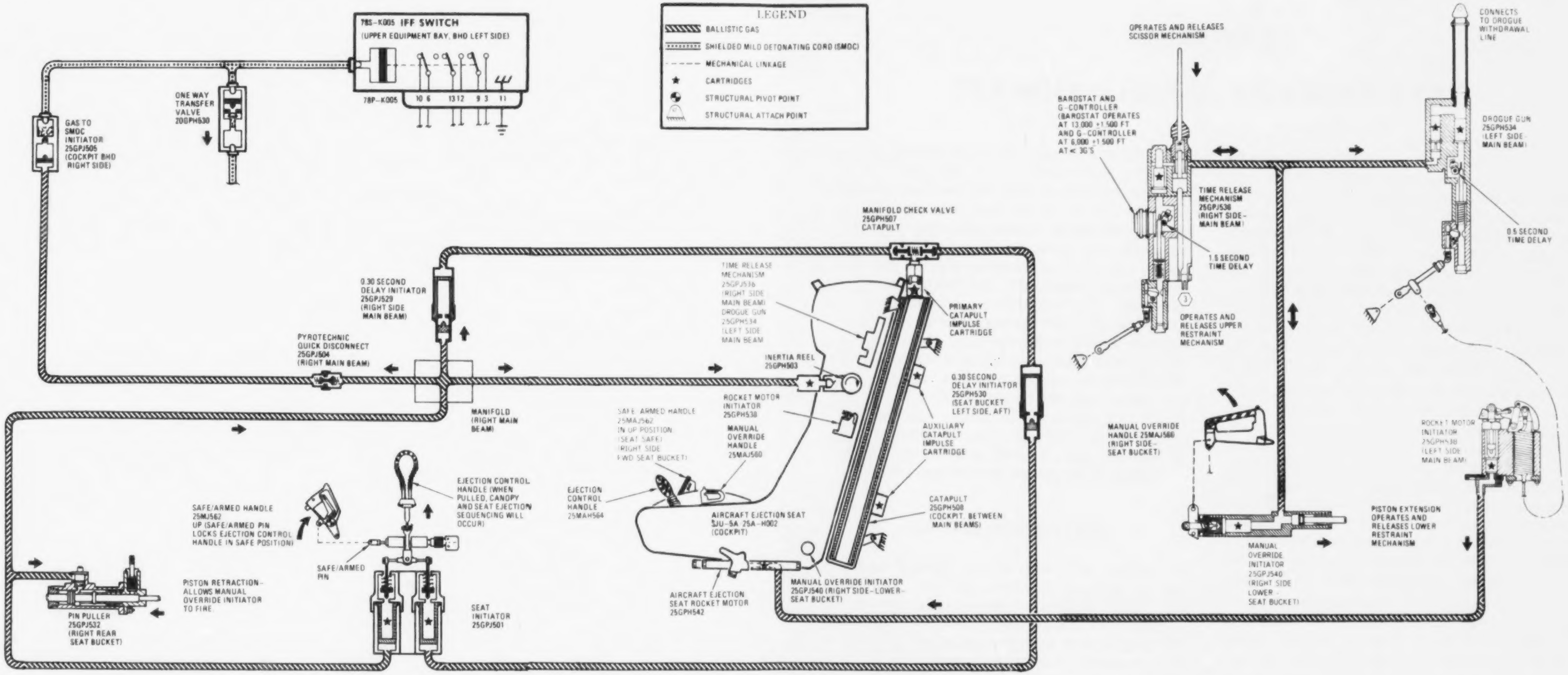
Aluminum Forgings and Castings

Metal removal should not exceed 0.005 inch in depth. You should apply chemical conversion coating (alodine) to bare surfaces and repaint them as required.

RESTORATION OF FINISH

Abrasions and isolated damage areas may be restored using the following procedure: First, mask the area to be painted. You should feather sand the paint around the damage with abrasive paper or Scotchbrite mat. Next, apply paint thinner or methyl ethyl ketone and wipe the area dry with cheesecloth before the solvent evaporates. At this point, if bare metal is showing, you should apply alodine and allow it to dry. Finally, apply one coat of primer and two coats of paint.

Special attention should be paid to the use of primers, polyurethane paints, paint removers, and methyl ethyl ketone. They are all flammable and toxic. Do not use them near open flames or sparks. Do not allow them to come in contact with your skin or eyes. Their use should be restricted to a well-ventilated area.


LEGEND
BALLISTIC GAS
SHIELDED MILD DETONATING CORD (SMDC)
MECHANICAL LINKAGE
CARTRIDGES
STRUCTURAL PIVOT POINT
STRUCTURAL ATTACH POINT
78S-K005 IFF SWITCH
(UPPER EQUIPMENT BAY, BHD LEFT SIDE)
78P-K005
10 6 13 12 9 3 11
ONE WAY TRANSFER VALVE 20BPH630
GAS TO SMDC INITIATOR 25GPJ505 (COCKPIT BHD RIGHT SIDE)
0.30 SECOND DELAY INITIATOR 25GPJ529 (RIGHT SIDE MAIN BEAM)
PYROTECHNIC QUICK DISCONNECT 25GPJ504 (RIGHT MAIN BEAM)
MANIFOLD (RIGHT MAIN BEAM)
MANIFOLD CHECK VALVE 25GPH507 CATAPULT
TIME RELEASE MECHANISM 25GPJ536 (RIGHT SIDE MAIN BEAM) DROGUE GUN 25GPH534 (LEFT SIDE MAIN BEAM
INERTIA REEL 25GPH503
PRIMARY CATAPULT IMPULSE CARTRIDGE
0.30 SECOND DELAY INITIATOR 25GPH530 (SEAT BUCKET LEFT SIDE, AFT)
ROCKET MOTOR INITIATOR 25GPH538
SAFE ARMED HANDLE 25MAJ562 IN UP POSITION (SEAT SAFE) (RIGHT SIDE FWD SEAT BUCKET)
MANUAL OVERRIDE HANDLE 25MAJ560
AUXILIARY CATAPULT IMPULSE CARTRIDGE
EJECTION CONTROL HANDLE 25MAH564
AIRCRAFT EJECTION SEAT SJU-5A 25A-H002 (COCKPIT)
CATAPULT 25GPH508 (COCKPIT, BETWEEN MAIN BEAMS)
AIRCRAFT EJECTION SEAT ROCKET MOTOR 25GPH542
MANUAL OVERRIDE INITIATOR 25GPJ540 (RIGHT SIDE-LOWER-SEAT BUCKET)
EJECTION CONTROL HANDLE (WHEN PULLED, CANOPY AND SEAT EJECTION SEQUENCING WILL OCCUR)
SAFE/ARMED HANDLE 25MJ562 UP (SAFE/ARMED PIN LOCKS EJECTION CONTROL HANDLE IN SAFE POSITION)
SAFE/ARMED PIN
SEAT INITIATOR 25GPJ501
PISTON RETRACTION-ALLOWS MANUAL OVERRIDE INITIATOR TO FIRE
PIN PULLER 25GPJ532 (RIGHT REAR SEAT BUCKET)
OPERATES AND RELEASES SCISSOR MECHANISM
BAROSTAT AND G-CONTROLLER (BAROSTAT OPERATES AT 13,000 ±1,500 FT AND G-CONTROLLER AT 6,000 ±1,500 FT AT ≪ 3G'S
TIME RELEASE MECHANISM 25GPJ536 (RIGHT SIDE-MAIN BEAM)
1.5 SECOND TIME DELAY
3
OPERATES AND RELEASES UPPER RESTRAINT MECHANISM
CONNECTS TO DROGUE WITHDRAWAL LINE
DROGUE GUN 25GPH534 (LEFT SIDE MAIN BEAM)
0.5 SECOND TIME DELAY
MANUAL OVERRIDE HANDLE 25MAJ560 (RIGHT SIDE-SEAT BUCKET)
MANUAL OVERRIDE INITIATOR 25GPJ540 (RIGHT SIDE LOWER - SEAT BUCKET)
PISTON EXTENSION OPERATES AND RELEASES LOWER RESTRAINT MECHANISM
ROCKET MOTOR INITIATOR 25GPH538 (LEFT SIDE MAIN BEAM)

214.208

Figure 2-6.—Ejection seat sequencing schematic.

CHAPTER 3

STENCEL SJU-8/A EJECTION SEAT

The Stencel SJU-8/A ejection seat is used in the A-7E aircraft. It uses thrust from a ballistic catapult and two seat-back rockets to propel it from the aircraft. (See figures 3-1, 3-2, and 3-3.) The seat provides escape capabilities during takeoff and landing emergencies from zero speed and zero altitude to speeds and altitudes of 600 knots and 50,000 feet. The system incorporates a seat-mounted, environmentally protected parachute, survival package with raft, emergency oxygen supply, and emergency locator beacon. The parachute is stored in a nonadjustable headrest. The front surface of the seat bucket provides a buffer for the calves of the legs, which are automatically restrained by straps to prevent flailing during ejection. The sides of the bucket extend upward and forward from the seat to protect the legs during canopy penetration.

SYSTEM DESCRIPTION

The Stencel system has four modes of operation. As you read the material in the following paragraphs, carefully note the differences between these modes. The material describing the subsystems and components will amplify the modes of operation by explaining how and when each mode is activated. The remainder of this section will address the test equipment and test procedures used in the maintenance of the system.

SYSTEM OPERATION

The ejection sequence is initiated by pulling upward on the ejection control handle, which is located on the front panel of the seat bucket. Pulling the ejection control handle requires a force of 15 to 25 pounds through a distance of less than four inches. Pulling the control handle fires two M99 ejection initiators, which release hot, high-pressure gas to the ballistic signal transmission system (BSTS). Figure 3-4 is a schematic of the BSTS. The right M99 ejection initiator supplies gas pressure to the right side of the catapult cartridge igniter and the inertia reel gas-generating initiator. The left M99 ejection initiator supplies gas pressure to the left side of the catapult cartridge igniter, thereby providing redundant ignition to the catapult cartridge.

As the seat catapult fires, the gas pressure forces locking pistons in the catapult tubes to disengage the locking balls, which unlock the inner and outer catapult tubes. As the seat and outer catapult tubes move upward, the pilot's legs are drawn against the front of the seat by the leg restraint mechanism. Simultaneously, the quick-disconnect fittings for pilot services are separated and a lanyard on the catapult manifold activates the emergency oxygen bottle, IFF, and AN/URT-33 emergency radio beacon.

After approximately 16 inches of seat travel, gas pressure is applied to the drogue gun pistons housed in the catapult tubes. These pistons forcibly expel the drogue parachute container for quick drogue parachute deployment. The drogue parachute provides seat stability and aids in withdrawing the main parachute.

After approximately 31 inches of seat travel, gas pressure is ported to a thruster (pin puller), a 3-second time delay initiator, a multiple time delay (0.1- and 1.3-seconds) initiator, and the igniters of the two seat-back rocket (SBR) motors. The SBRs produce the thrust necessary for the seat and pilot to attain sufficient terrain and aircraft tail clearance to permit parachute deployment.

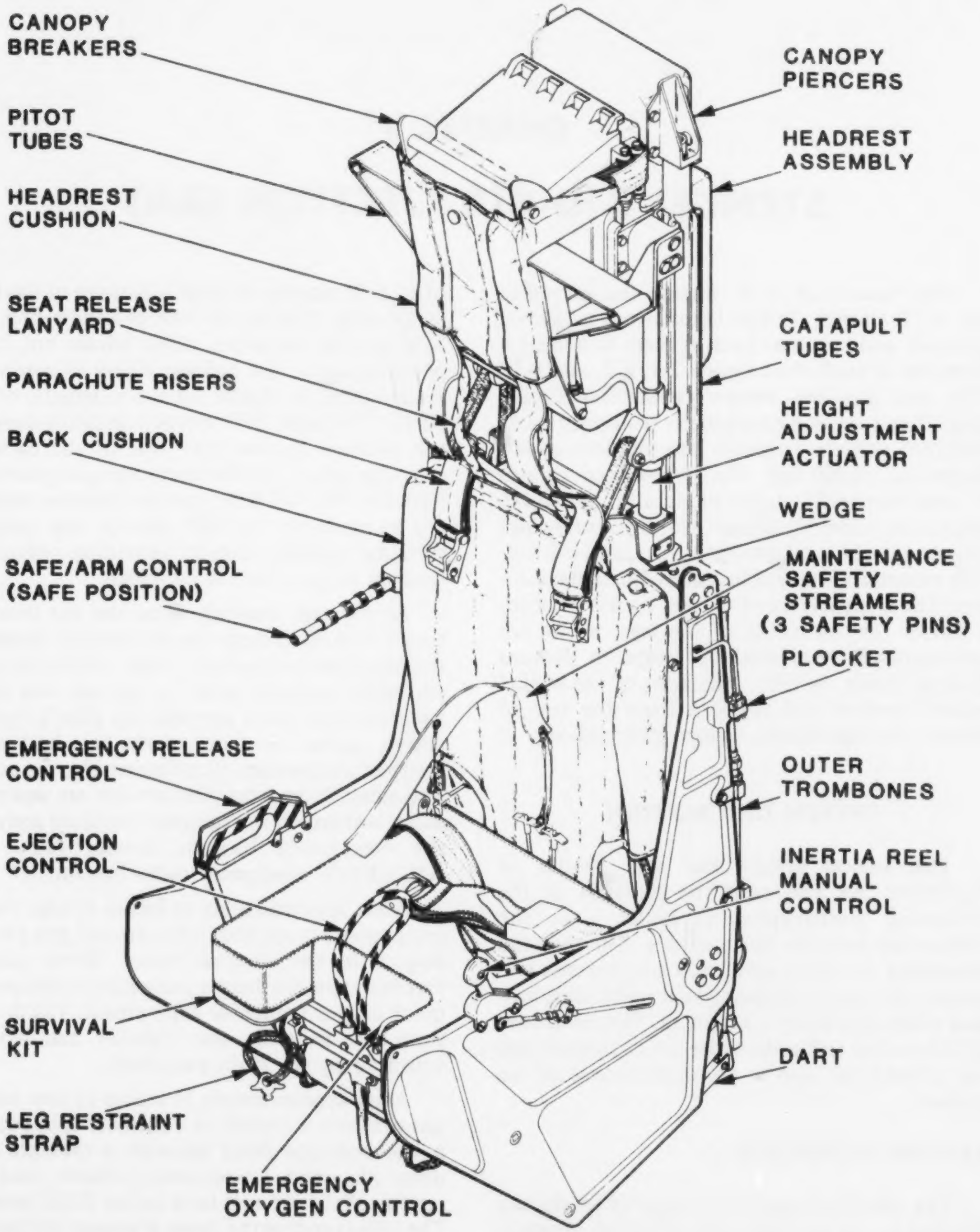

CANOPY BREAKERS
PITOT TUBES
HEADREST CUSHION
SEAT RELEASE LANYARD
PARACHUTE RISERS
BACK CUSHION
SAFE/ARM CONTROL (SAFE POSITION)
EMERGENCY RELEASE CONTROL
EJECTION CONTROL
SURVIVAL KIT
LEG RESTRAINT STRAP
EMERGENCY OXYGEN CONTROL
CANOPY PIERCERS
HEADREST ASSEMBLY
CATAPULT TUBES
HEIGHT ADJUSTMENT ACTUATOR
WEDGE
MAINTENANCE SAFETY STREAMER (3 SAFETY PINS)
PLOCKET
OUTER TROMBONES
INERTIA REEL MANUAL CONTROL
DART
214.183

Figure 3-1.—SJU-8/A ejection seat assembly.

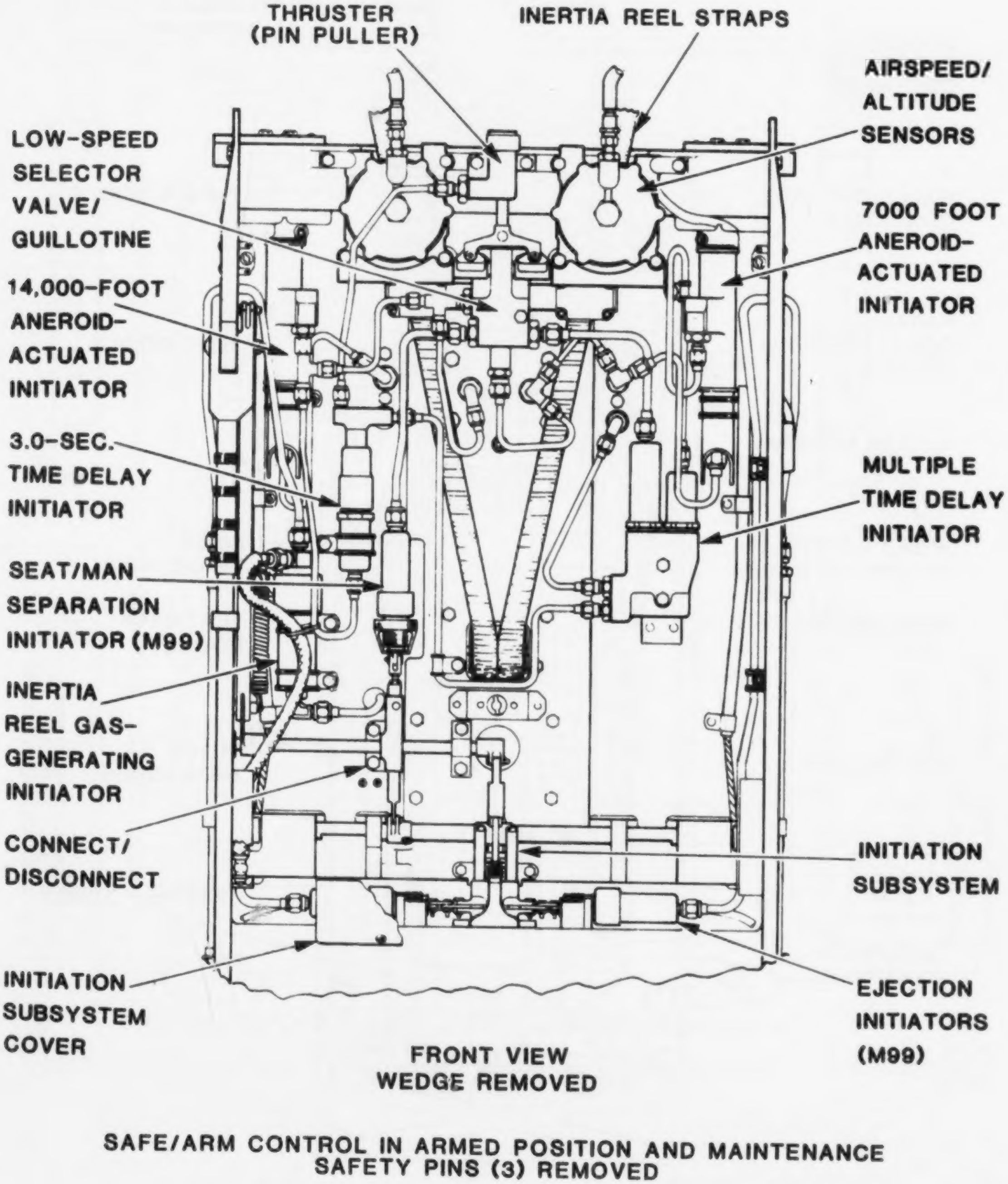
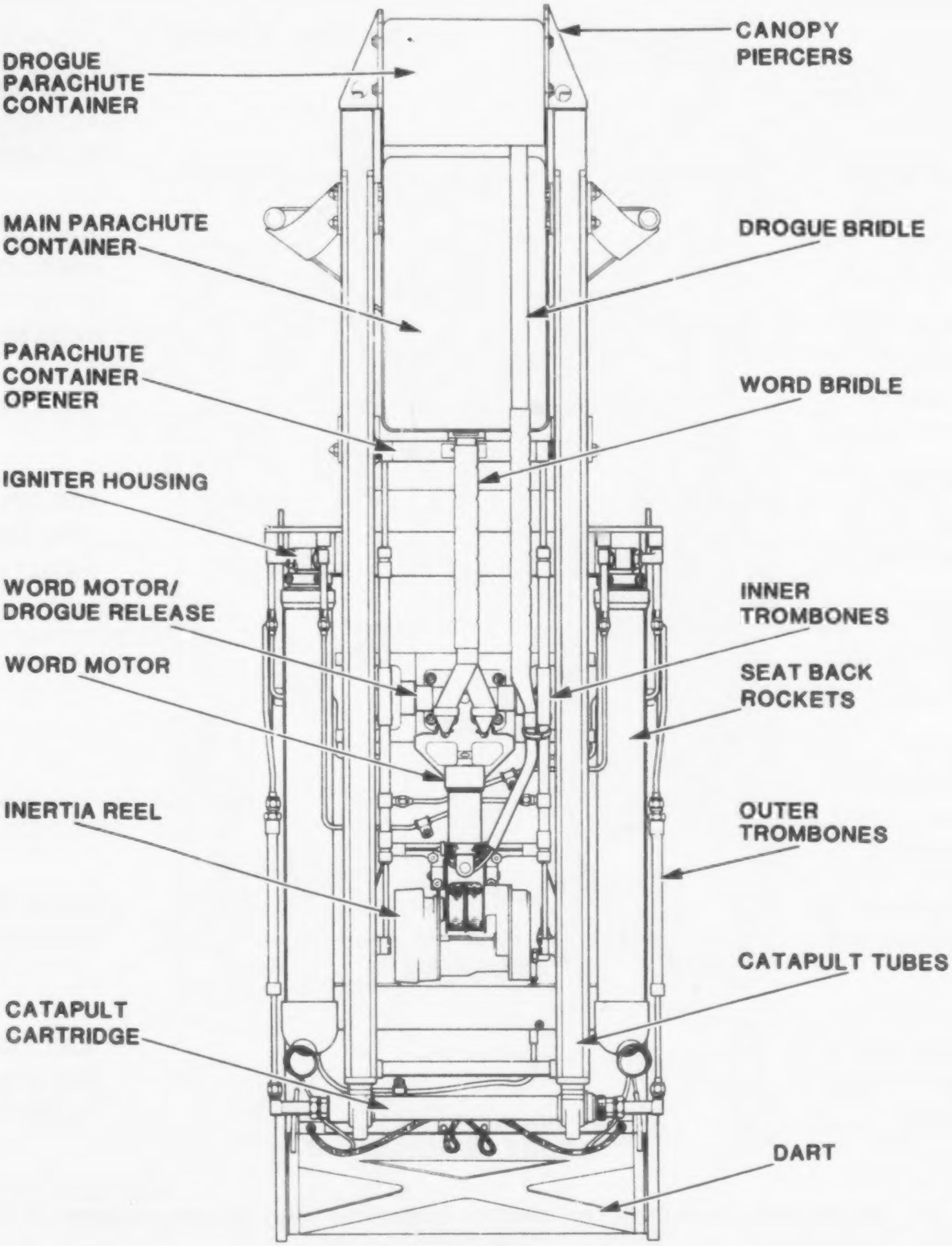

THRUSTER (PIN PULLER)
INERTIA REEL STRAPS
AIRSPEED/ ALTITUDE SENSORS
LOW-SPEED SELECTOR VALVE/ GUILLOTINE
7000 FOOT ANEROID-ACTUATED INITIATOR
14,000-FOOT ANEROID-ACTUATED INITIATOR
3.0-SEC. TIME DELAY INITIATOR
MULTIPLE TIME DELAY INITIATOR
SEAT/MAN SEPARATION INITIATOR (M99)
INERTIA REEL GAS-GENERATING INITIATOR
CONNECT/ DISCONNECT
INITIATION SUBSYSTEM
INITIATION SUBSYSTEM COVER
EJECTION INITIATORS (M99)
FRONT VIEW WEDGE REMOVED
SAFE/ARM CONTROL IN ARMED POSITION AND MAINTENANCE SAFETY PINS (3) REMOVED
214.184

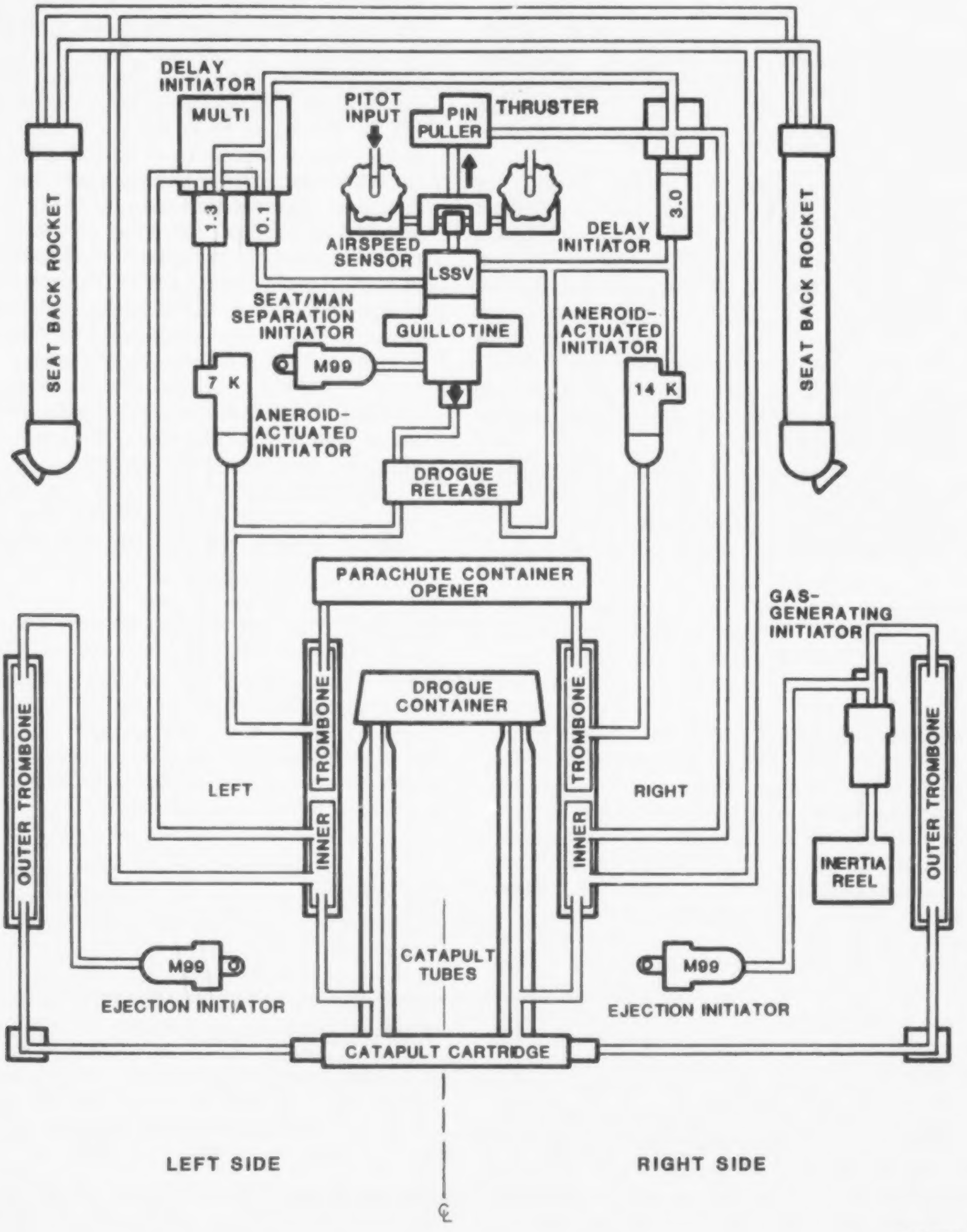
Figure 3-2.—SJU-8/A ejection seat assembly.


DROGUE PARACHUTE CONTAINER
CANOPY PIERCERS
MAIN PARACHUTE CONTAINER
DROGUE BRIDLE
PARACHUTE CONTAINER OPENER
WORD BRIDLE
IGNITER HOUSING
WORD MOTOR/ DROGUE RELEASE
INNER TROMBONES
WORD MOTOR
SEAT BACK ROCKETS
INERTIA REEL
OUTER TROMBONES
CATAPULT TUBES
CATAPULT CARTRIDGE
DART

BACK VIEW

214.185

Figure 3-3.—SJU-8/A ejection seat assembly.


DELAY INITIATOR
MULTI
PITOT INPUT
PIN PULLER
THRUSTER
1.3
0.1
3.0
AIRSPEED SENSOR
DELAY INITIATOR
LSSV
SEAT/MAN SEPARATION INITIATOR
GUILLOTINE
M99
ANEROID-ACTUATED INITIATOR
7 K
14 K
ANEROID-ACTUATED INITIATOR
DROGUE RELEASE
SEAT BACK ROCKET
SEAT BACK ROCKET
PARACHUTE CONTAINER OPENER
GAS-GENERATING INITIATOR
DROGUE CONTAINER
OUTER TROMBONE
TROMBONE
TROMBONE
OUTER TROMBONE
LEFT
RIGHT
INNER
INNER
INERTIA REEL
CATAPULT TUBES
M99
EJECTION INITIATOR
M99
EJECTION INITIATOR
CATAPULT CARTRIDGE
LEFT SIDE
RIGHT SIDE
℄

214.186

Figure 3-4.—SJU-8/A ballistic signal transmission system.

The necessary thrust is available even at zero airspeed and zero altitude.

Upon ejection, the seat is stabilized by a Directional Automatic Realignment of Trajectory (DART) system. Two lanyards, attached to the aircraft and feeding through tension brake assemblies beneath the seat, counteract excessive pitch and roll.

The post-ejection sequencing system for deploying the Wind Oriented Rocket Deployment (WORD) motor and drogue release mechanism follows one of four automatic ejection modes, depending on the aircraft's airspeed and altitude. These modes of operation will be discussed later in this chapter. Depending on the mode of operation, the time delay initiators fire, directing gas pressure to actuate the WORD motor and drogue release mechanism, and arm the aneroid-actuated initiator.

Upon actuation, the WORD motor/drogue release disconnects the WORD rocket motor. This allows the wind resistance on the drogue chute to withdraw the WORD motor from the seat. When the WORD rocket motor arming cable is withdrawn, it releases the firing pin and ignites the rocket. Depending on the mode of operation, the aneroid-actuated initiator fires. This activates the personnel parachute container opener, releasing the personnel parachute. The parachute will be withdrawn by either the WORD rocket motor, drogue parachute, or internal pilot chute.

When the personnel parachute suspension lines and risers become taut, a firing lanyard attached to a ballistic spreading gun extracts the spreading gun firing pin sear. The released firing pin strikes and activates a spreading-gun ballistic charge which expels metal slugs in a 360-degree pattern. The slugs, attached to parachute suspension lines, rapidly inflate the canopy during very low-speed ejection. During high-speed ejection, the airstream energy far exceeds that of the spreading gun. Therefore, the gun has little effect on parachute inflation time.

As wind resistance acts on the personnel parachute, tension on the seat and man release lanyards actuates the seat and man separation

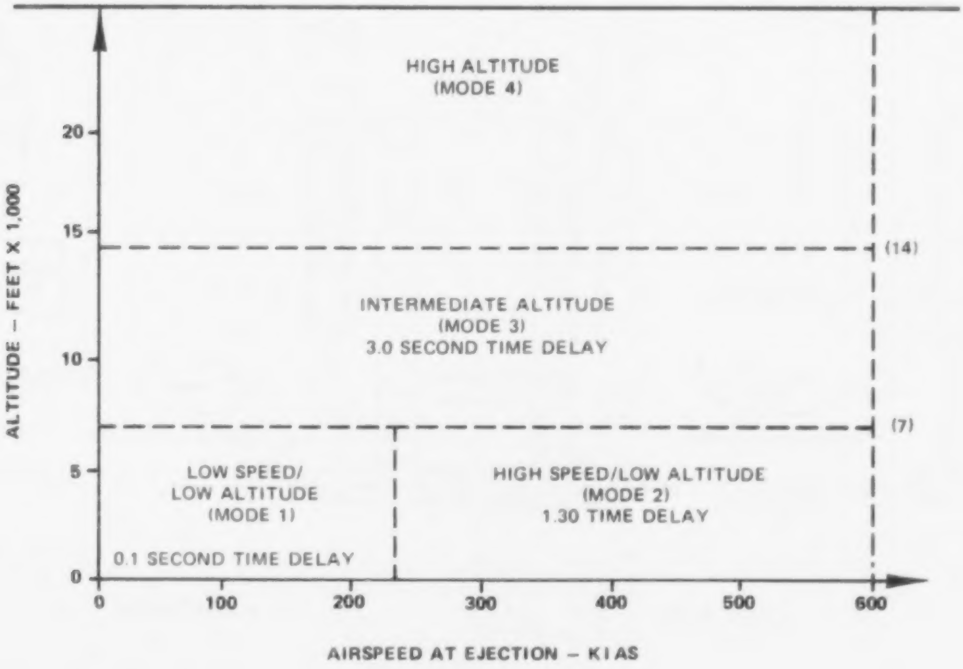


Figure 3-5.—SJU-8/A modes of operation.

initiator to produce gas pressure directed to the guillotine. The guillotine severs both inertia reel straps and releases the pilot's upper torso. Simultaneous actuation of seat and man separation mechanical linkage by the lanyards releases the survival kit assembly and pilot from the ejection seat.

The pilot may release the survival package in the survival kit by pulling a handle located near his right hip. After the package drops 12 feet, a snubbing lanyard initiates inflation of the life raft. The remainder of the survival package drops an additional 13 feet and hangs below the life raft to stabilize it during descent.

Ejection Mode Sequences

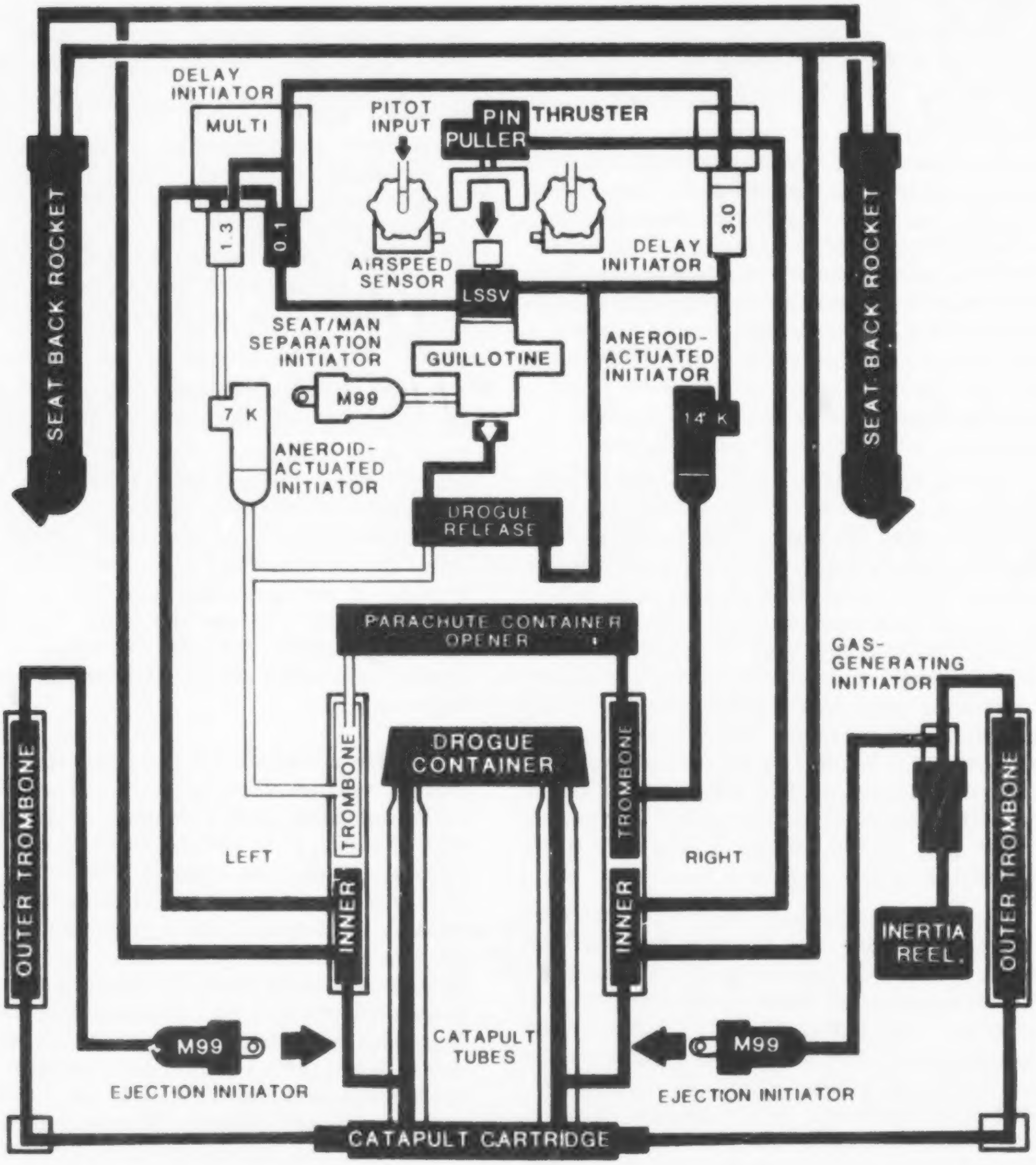
The Stencel seat is equipped with a mode sequencing system which controls four automatic ejection modes. The system includes a parachute container opener that is activated by gas pressure from the 7,000- or 14,000-foot aneroid initiators, or the seat and man separation initiator. The WORD rocket is also part of the system. The WORD rocket, mounted on the back of the seat, is connected to the drogue bridle assembly on one end and to the parachute WORD bridle on the other end. The WORD rocket motor is released from the seat and fired by a lanyard as it falls away from the seat during low-speed ejections or by the pull of the drogue during high-speed ejections.

The ejection sequence follows one of four modes, depending on aircraft airspeed and altitude. Mode 1 includes ejections where the aircraft is operating below 7,000 feet and at a speed less than 225 knots. Mode 2 includes an altitude below 7,000 feet, but at a speed greater than 225 knots. Mode 3 occurs above 7,000 feet, but below 14,000 feet, at any airspeed. Mode 4 occurs above 14,000 feet at any airspeed. Figure 3-5 presents a comparison of the various modes.

MODE 1.—Mode 1 is for a low-speed, low-altitude ejection. (See figure 3-6.) After the catapult outer tube assemblies have traveled upward a distance of approximately 31 inches, ballistic gases are ported through the inner trombone assemblies to actuate the 0.1- and 1.3-second time delays in the multiple delay initiator and the 3-second delay initiator. Gases from the 0.1-second delay actuate the drogue and WORD release and arm the 14,000-foot aneroid initiator. Below 14,000 feet, the initiator immediately actuates and gases pass through the right trombone to actuate the parachute container opener. Upon actuation of the WORD motor and drogue release assembly, the aerodynamic drag of the drogue parachute pulls the WORD motor away from the seat back. This action extracts the firing lanyard from the motor and ignites the WORD motor.

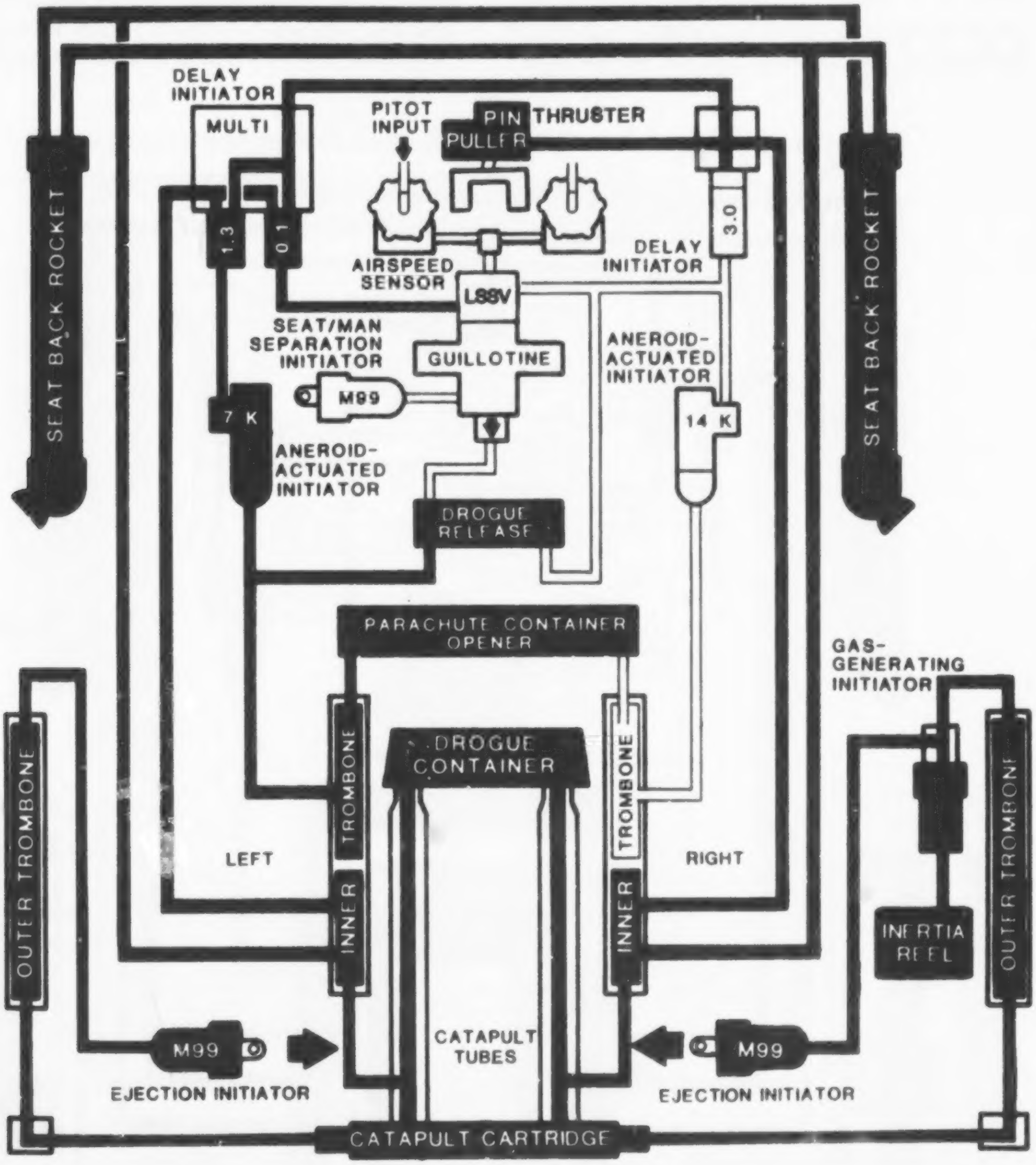
When the WORD rocket is fired, it extracts the parachute from its container. The parachute drag pulls a lanyard that fires the ballistic spreading gun. The gun expels metal slugs, which are attached to alternate suspension lines on the parachute canopy skirt in a radial pattern. This opens the parachute and allows the canopy to fill quickly. If the spreading gun fails to fire, a fail-safe collar releases the slugs and allows normal parachute inflation. If mode 1 fails, mode 2 will automatically provide the ejection sequence.

MODE 2.—Mode 2 is for a high-speed, low-altitude ejection. (See figure 3-7.) The primary initiation of the mode 2 sequence is identical to that of mode 1. In order to reduce parachute opening loads, the drogue decelerates and stabilizes the seat before the parachute opens. In mode 2, the output of the 0.1-second initiator is blocked by the low-speed selector valve (LSSV) because airspeed is above 225 knots. The flow of gases is delayed until the 1.3-second delay initiator fires. This delay reduces the parachute's opening shock. When the 1.3-second delay initiator fires, the ballistic gases are directed to the 7,000-foot aneroid-actuated initiator. Since the altitude is below 7,000 feet, the initiator fires. This actuates the WORD motor and drogue release assembly and operates the parachute container opener assembly. The remainder of the mode 2 sequence is identical to the mode 1 sequence. If the mode 2 sequence should fail, then the mode 3 sequence automatically provides the ejection sequence.


DELAY INITIATOR
MULTI
PITOT INPUT
PIN PULLER
THRUSTER
1.3
0.1
AIRSPEED SENSOR
3.0
DELAY INITIATOR
LSSV
SEAT BACK ROCKET
SEAT BACK ROCKET
SEAT/MAN SEPARATION INITIATOR
GUILLOTINE
ANEROID-ACTUATED INITIATOR
M99
7 K
14 K
ANEROID-ACTUATED INITIATOR
DROGUE RELEASE
PARACHUTE CONTAINER OPENER
GAS-GENERATING INITIATOR
OUTER TROMBONE
TROMBONE
DROGUE CONTAINER
TROMBONE
OUTER TROMBONE
LEFT
RIGHT
INNER
INNER
INERTIA REEL
M99
CATAPULT TUBES
M99
EJECTION INITIATOR
EJECTION INITIATOR
CATAPULT CARTRIDGE

214.187

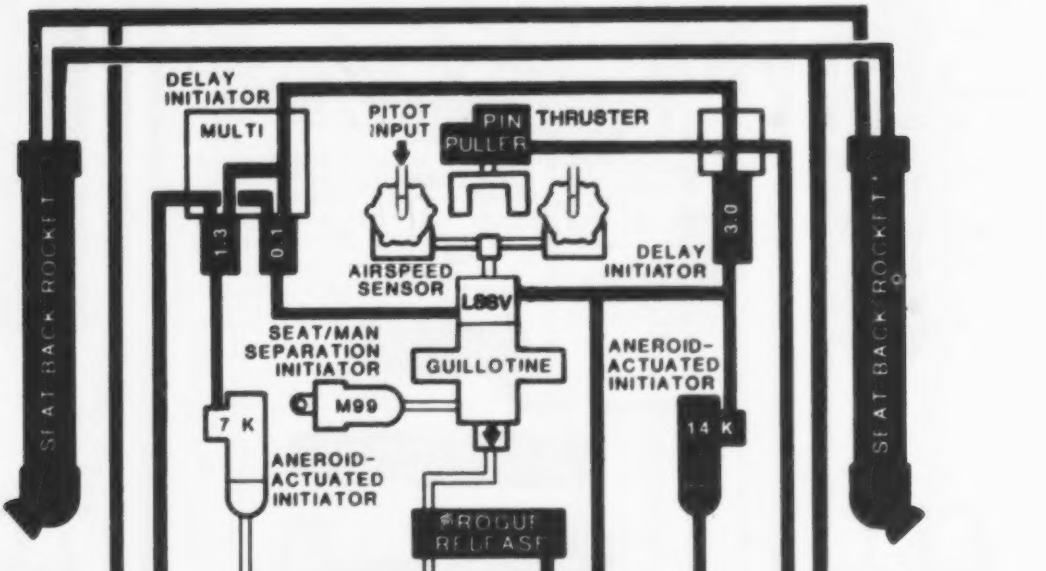
Figure 3-6.—Mode 1: Low speed/low altitude.


DELAY INITIATOR
MULTI
1.3
0.1
PITOT INPUT
PIN PULLER
THRUSTER
3.0
DELAY INITIATOR
AIRSPEED SENSOR
LSSV
SEAT/MAN SEPARATION INITIATOR
GUILLOTINE
M99
7 K
ANEROID-ACTUATED INITIATOR
ANEROID-ACTUATED INITIATOR
14 K
DROGUE RELEASE
SEAT BACK ROCKET
SEAT BACK ROCKET
PARACHUTE CONTAINER OPENER
GAS-GENERATING INITIATOR
TROMBONE
TROMBONE
DROGUE CONTAINER
LEFT
RIGHT
INNER
INNER
OUTER TROMBONE
OUTER TROMBONE
INERTIA REEL
M99
M99
CATAPULT TUBES
EJECTION INITIATOR
EJECTION INITIATOR
CATAPULT CARTRIDGE

214.188

Figure 3-7.—Mode 2: High speed/low altitude.

MODE 3.—Mode 3 is an intermediate altitude (above 7,000 feet and below 14,000 feet) ejection which may occur at any airspeed. (See figure 3-8.) The primary initiation of the mode 3 sequence is identical to that of mode 1. At ejection, the airspeed and altitude sensors and low-speed selector valve (LSSV) block the gases from the 0.1-second delay initiator. The 1.3-second delay initiator fires and arms the 7,000-foot aneroid initiator, which is delayed because ejection occurs

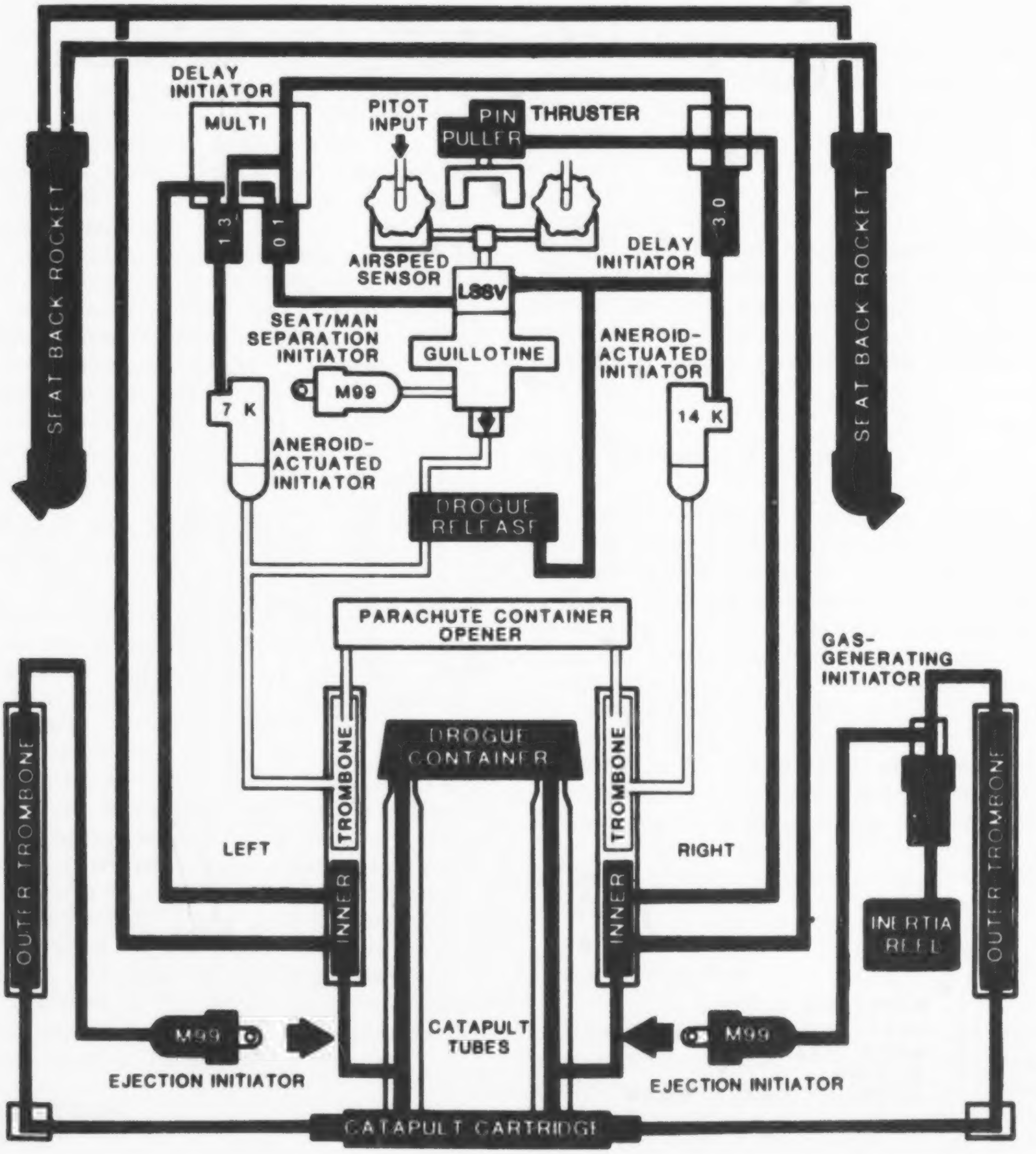

DELAY
INITIATOR
MULTI
PITOT
INPUT
PIN
PULLER
THRUSTER
1.3
0.1
3.0
AIRSPEED
SENSOR
DELAY
INITIATOR
LSSV
SEAT BACK ROCKET
SEAT BACK ROCKET
SEAT/MAN
SEPARATION
INITIATOR
GUILLOTINE
ANEROID-
ACTUATED
INITIATOR
M99
7 K
14 K
ANEROID-
ACTUATED
INITIATOR
DROGUE
RELEASE
GAS-
GENERATING
INITIATOR
OUTER TROMBONE
TROMBONE
DROGUE
CONTAINER
TROMBONE
OUTER TROMBONE
LEFT
RIGHT
INNER
INNER
INERTIA
REEL
M99
M99
CATAPULT
TUBES
EJECTION INITIATOR
EJECTION INITIATOR
CATAPULT CARTRIDGE

214.189

Figure 3-8.—Mode 3: Intermediate altitude.

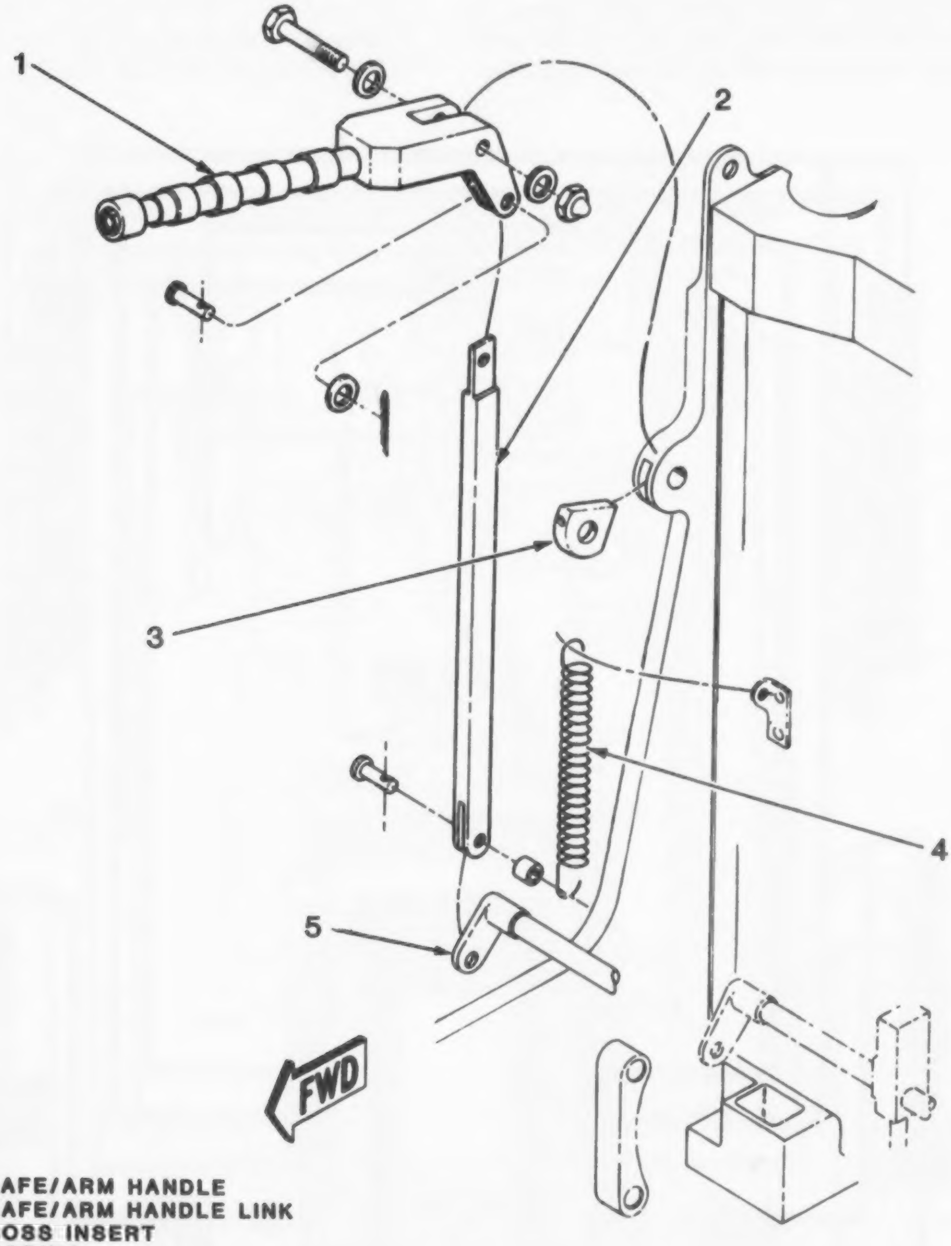
above 7,000 feet. When the 3-second delay initiator fires, its gases actuate the drogue and WORD release and arm the 14,000-foot aneroid initiator. Since ejection occurs below 14,000 feet, the initiator fires immediately through the right trombone to operate the parachute container opener. The remainder of mode 3 is identical to mode 1.

MODE 4.—Mode 4 is an ejection above 14,000 feet at any airspeed. (See figure 3-9.) The


DELAY INITIATOR
MULTI
PITOT INPUT
PIN PULLER
THRUSTER
1.3
0.1
3.0
AIRSPEED SENSOR
DELAY INITIATOR
LSSV
SEAT BACK ROCKET
SEAT BACK ROCKET
SEAT/MAN SEPARATION INITIATOR
GUILLOTINE
ANEROID-ACTUATED INITIATOR
M99
7 K
14 K
ANEROID-ACTUATED INITIATOR
DROGUE RELEASE
PARACHUTE CONTAINER OPENER
GAS-GENERATING INITIATOR
TROMBONE
TROMBONE
DROGUE CONTAINER
LEFT
RIGHT
OUTER TROMBONE
OUTER TROMBONE
INNER
INNER
INERTIA REEL
M99
M99
CATAPULT TUBES
EJECTION INITIATOR
EJECTION INITIATOR
CATAPULT CARTRIDGE

214.190

Figure 3-9.—Mode 4: High speed/high altitude.



1. SAFE/ARM HANDLE
2. SAFE/ARM HANDLE LINK
3. BOSS INSERT
4. SPRING
5. OUTBOARD BELLCRANK

214.191

Figure 3-10.—Safe/Arm control assembly and link.

primary initiation of the mode 4 sequence is identical to that of mode 1. At ejection, the ballistic gases from the 3-second delay initiator actuate the WORD motor and drogue release assembly and arm the 14,000-foot aneroid-actuated initiator. Meanwhile, the 1.3-second delay initiator arms the 7,000-foot aneroid-actuated initiator, which acts as a back-up. The seat and pilot, which are stabilized by the drogue parachute, descend to 14,000 feet pressure altitude. At that point, the 14,000-foot aneroid-actuated initiator fires actuating the personnel parachute container opener assembly. The personnel parachute assembly is then deployed by the aerodynamic forces acting on the drogue parachute assembly.

Should either the 3-second delay initiator or the 14,000-foot aneroid-actuated initiator fail, the sequence would proceed as described above, except that free fall would continue to 7,000 feet pressure altitude. There the 7,000-foot aneroid-actuated initiator would actuate the personnel parachute container opener assembly. The personnel parachute assembly would then be deployed by the drogue parachute assembly.

Emergency Parachute Operation and Seat Separation

If all automatic modes fail after the seat is ejected, the emergency release handle may be used for parachute deployment or seat and pilot separation. Operation of the emergency release handle overrides all automatic modes, but it should not normally be used above 14,000 feet.

Upon actuation, mechanical linkage fires the seat and man separation initiator directing ballistic gas to the inertia reel strap guillotine. The guillotine severs two straps and releases the pilot's upper torso restraint. Ballistic gas also actuates both the WORD motor and drogue release assembly and the parachute container opener assembly. The personnel parachute assembly is then deployed by the drogue and the WORD motor, depending upon airspeed at the time of manual override initiation.

SUBSYSTEMS

There are several functional subsystems of the Stencel SJU-8/A ejection seat. The subsystems are described in the approximate order in which they operate in the ejection sequence.

Safe and Arm Control Subsystems

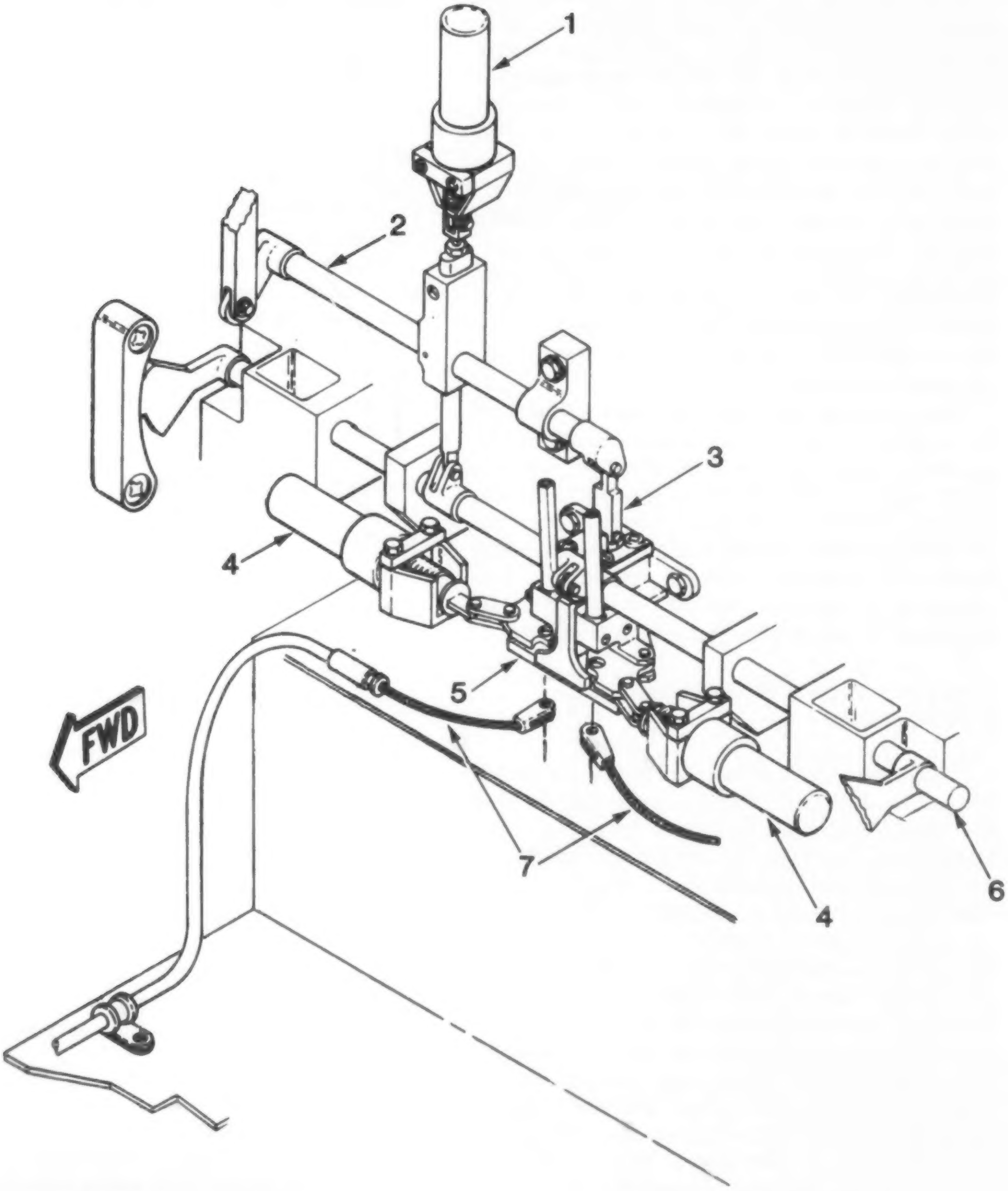
The safe and arm control subsystem places the seat in either a safe or an armed condition. (See figures 3-10 and 3-11.) The subsystem safeties three mechanically actuated M99 initiators when the seat is not occupied or when it needs to be kept in the safe condition. For the safe position, you should pull the knob on the handle to disengage the lock. Then move the handle to the full UP position. The seat is safetied by mechanically positioning a link and plunger, which prevents rotation of the initiation subsystem rotors. It also safeties the linkage that actuates the seat and man separation initiator. For the armed position, you should pull the knob on the handle and move the handle to the full DOWN position.

Ejection Initiation Subsystem

The ejection initiation subsystem consists of an ejection control handle, mechanical linkage, and two ejection initiators. (See figure 3-11.) Actuation of the ejection control handle, located on the front panel of the seat bucket, mechanically pulls the firing cable, rotating the initiation subsystem rotors, which, in turn, extract a firing pin from each of the two M99 ejection initiators. The output gas pressure from either or both of the initiators is transmitted to two igniters, one on each side of the catapult cartridge, the inertia reel gas-generating initiator, the multiple time-delay initiator, and the thruster. The two catapult cartridge igniters provide catapult ignition redundancy.

Catapult Subsystem

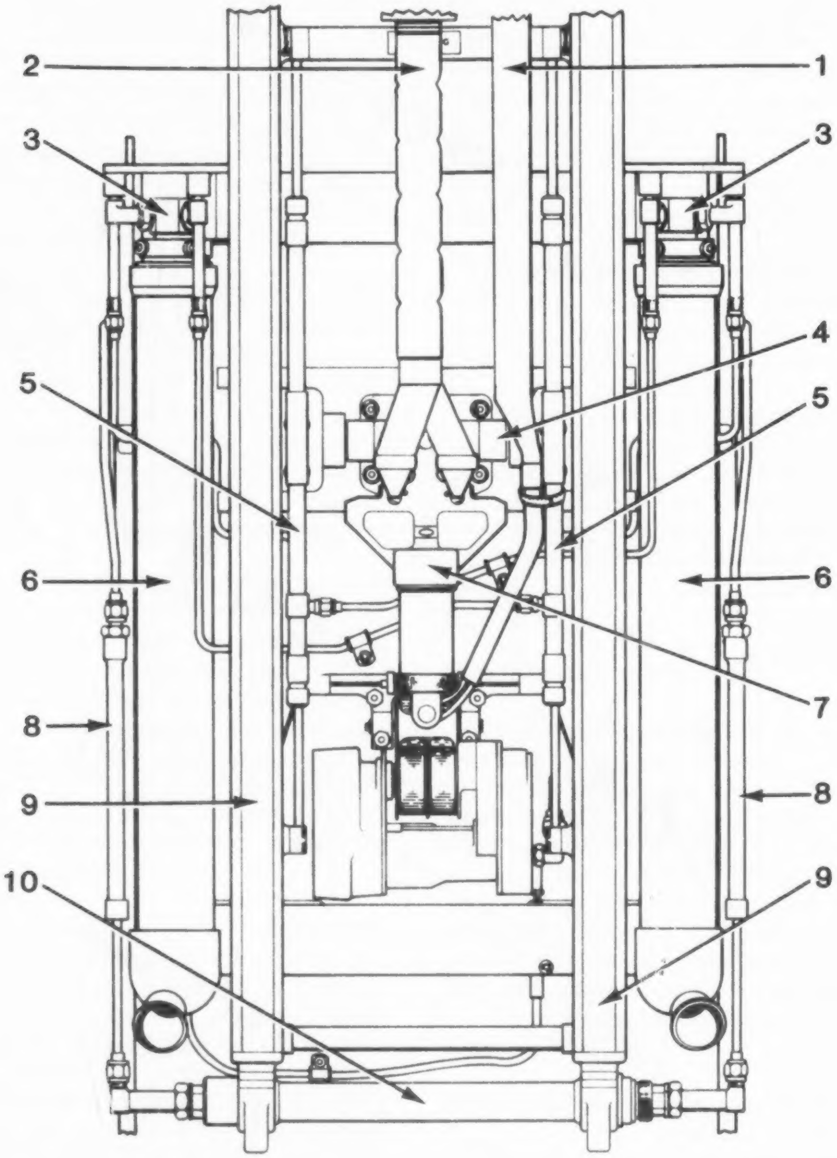
The catapult subsystem provides seat propulsion throughout the catapult stroke and applies pressure to the drogue pistons that project the drogue parachute and its container upward into the airstream. It also provides ballistic gas to initiate seat-back rocket ignition and post-ejection sequencing operations. (See figure 3-12.)



1. Seat/Man separation initiator
2. Connect/Disconnect assembly
3. Safety plunger
4. Ejection initiators
5. Initiator subsystem assembly
6. Seat release shaft
7. Ejection control handle cables
8. Safe/Arm handle link

214.192

Figure 3-11.—Ejection initiation system.



1. Drogue bridle
2. WORD bridle
3. Igniter housings
4. WORD motor/drogue release
5. Inner trombones
6. Seat-Back rockets
7. WORD motor
8. Outer trombones
9. Catapult tubes
10. Catapult cartridge

214.193

Figure 3-12.—Catapult system.

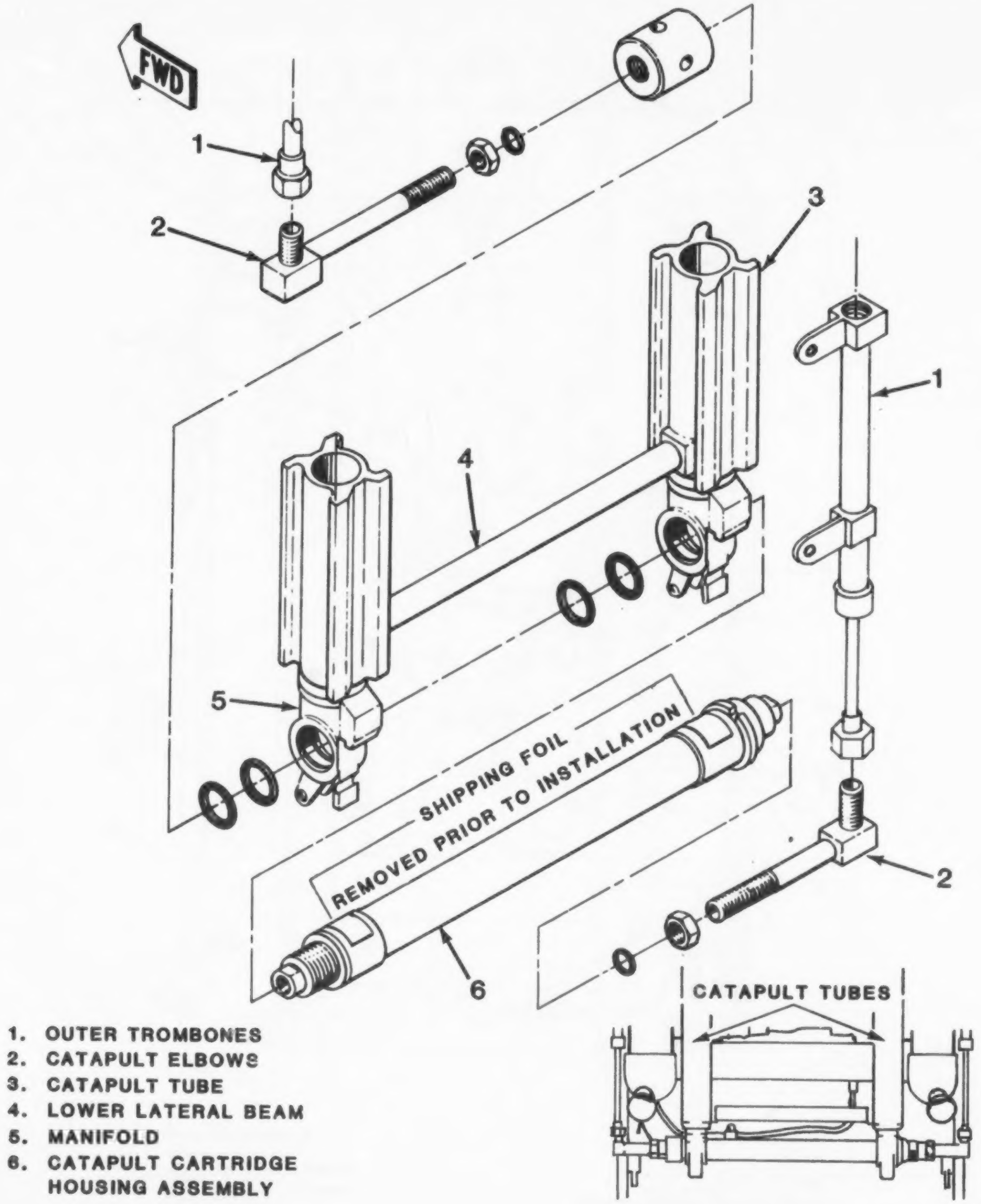

FWD
1
2
3
1
4
5
SHIPPING FOIL
REMOVED PRIOR TO INSTALLATION
2
6
CATAPULT TUBES
1. OUTER TROMBONES
2. CATAPULT ELBOWS
3. CATAPULT TUBE
4. LOWER LATERAL BEAM
5. MANIFOLD
6. CATAPULT CARTRIDGE HOUSING ASSEMBLY
214.194

Figure 3-13.—Catapult cartridge and tube assemblies.

This subsystem may be divided into five major parts. These parts are described in the following paragraphs.

CATAPULT CARTRIDGE.—The catapult cartridge provides ballistic gas pressure to boost the seat and pilot out of the cockpit and to expel the drogue container and chute from the seat. The catapult cartridge also initiates ignition of two SBR motors and initiates the post-ejection sequencing subsystem. (See figure 3-13.)

CATAPULT TUBE ASSEMBLIES.—The catapult tube assemblies house the catapult lock and unlock mechanism, provide physical support for the seat bucket via the seat height adjustment actuator and slipper assemblies, and support the trombone assemblies. They also support a headrest and personnel parachute container assembly, drogue parachute and container assemblies, and associated interconnecting hardware.

The catapult tube assemblies also provide several other functions. First, they provide the energy and movement for the canopy piercers and breakers to penetrate the aircraft canopy. They also route and apply ballistic gas pressure to eject the drogue container and parachute. They route and apply ballistic gas pressure to initiate the seat-back rocket motors. Finally, they route and apply ballistic gas pressure to initiate the gas-operated components of the post-ejection sequencing subsystem. (See figure 3-13.)

CATAPULT LOCK AND UNLOCK MECHANISM.—The catapult lock consists of a locking piston and six locking balls set between the inner and outer catapult tubes. The catapult lock retains the seat in the cockpit during inverted flight. Upon seat ejection, the lock is released by gas pressure from the catapult cartridge. Catapult cartridge gases move the locking piston upward and permit the locking balls to disengage from the groove in the outer catapult tube. This action removes all connection between the inner and outer catapult tubes.

DROGUE CHUTE AND CONTAINER PROJECTION.—When the outer catapult tubes have moved upward approximately 16 inches on the inner tubes, gas pressure is applied to the pistons attached to the drogue container. There is one piston in each outer tube. When the pistons exit the top of the outer catapult tubes, the drogue container and parachute move up and aft of the seat. Then, aerodynamic pressure is applied to the container. This causes stretching of the drogue bridle and loosening of the drogue container flaps. The drogue suspension lines and canopy then emerge while the container and associated hardware are jettisoned. (See figure 3-14.)

TROMBONE ASSEMBLIES.—Two pairs of trombone assemblies are associated with the catapult. The outer trombone assemblies route ballistic gas from two M99 ejection initiators to the catapult cartridge igniters.

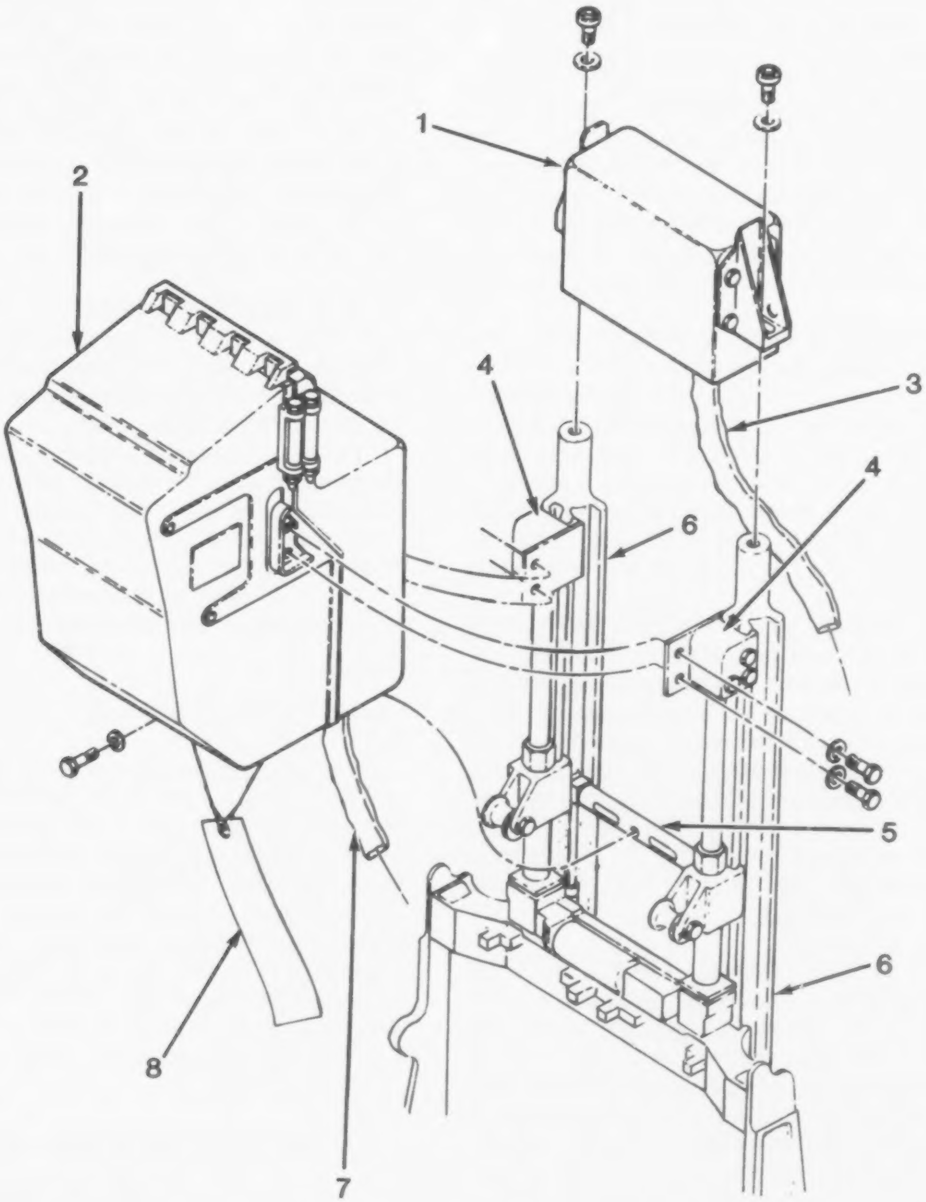
The inner trombone assemblies route ballistic gas pressure from the catapult tube assemblies to components of the post-ejection sequencing subsystems and to both seat-back rockets (SBR). They also route ballistic gas pressure from the 7,000- and 14,000-foot aneroid-actuated initiators to the parachute container opener. (See figure 3-12.)

Sustainer Thrust Subsystem

During either mode 1 or mode 2 operation, two SBR motors provide the thrust necessary to propel the seat and pilot to an altitude sufficient to attain terrain and aircraft tail clearance and to allow personnel parachute deployment and inflation. Each SBR has dual-ignition inlet ports. Ballistic gas pressure from both catapult tube assemblies is ported into both SBRs to provide redundant ignition. This pressure fires internal SBR igniters, which ignite the propellant grain for a burn time of approximately 0.25 second. (See figure 3-12.)

DART Stabilization Subsystem

The directional automatic realignment of trajectory (DART) stabilization subsystem, composed of a bridle, a brake assembly, and two nylon slip lines, provides stabilization for the seat and pilot during low-speed ejections. Stabilization is accomplished by correcting any misalignment of the seat and pilot center of gravity relative to the SBR thrust center line. One end of the bridle is permanently attached to the under side of



1. Drogue container assembly
2. Headrest assembly
3. Drogue bridle
4. Supports
5. Parachute container opener
6. Catapult tubes
7. WORD bridle
8. Headrest safety pin assembly

214.195

Figure 3-14.—Headrest and drogue container assemblies.

the seat bucket. It acts as a hinge during DART operation. Cables attached to the other end of the bridle restrict the arc of the bridle to a predetermined angle. This ensures optimum operation. Part of each slip line is stowed in a protective fabric housing routed through the brake assembly. The remainder of the two slip lines is stowed in a second protective fabric housing after being routed through fairleads on the bridle aft side. Free ends of the slip lines are attached to the catapult cartridge manifolds of the ejection seat. Slack in the slip line permits the seat to travel through seat tip-off and initial rotation, which results from center of gravity and thrust center line misalignment. Tension developed in the slip lines by the brake assembly imparts a correcting moment to the seat and pilot. This is necessary to counteract excessive seat and pilot pitch rotation and also to provide trajectory control.

Post-ejection Sequencing Subsystem

The post-ejection sequencing subsystem includes all gas-operated and cartridge-actuated devices required to initiate operational mode sequencing functions. It also includes the WORD rocket motor, the primary means for personnel parachute deployment in the inertia-WORD (I-WORD) rocket motor deployment sequence of mode 1, and the back-up means for the drogue-WORD deployment sequence of modes 2, 3, and 4.

Personnel Parachute Subsystem

The personnel parachute subsystem includes a WORD bridle assembly, riser assemblies with lanyards, spring-loaded internal pilot parachute assembly, main canopy assembly, ballistic spreading-gun assembly, and an override and disconnect assembly. The riser assemblies with lanyards initiate the spreading gun and the seat and man separation.

When the parachute container opener is actuated, either one of the two locking clips will disengage and release a ball fitting on the end of a restraining cable. This action allows the container to open and the main canopy assembly to deploy. The canopy assembly is propelled by the WORD bridle which is acted upon by the force of the drogue and WORD motor. Should the WORD bridle fail, the internal pilot parachute functions as a back-up system.

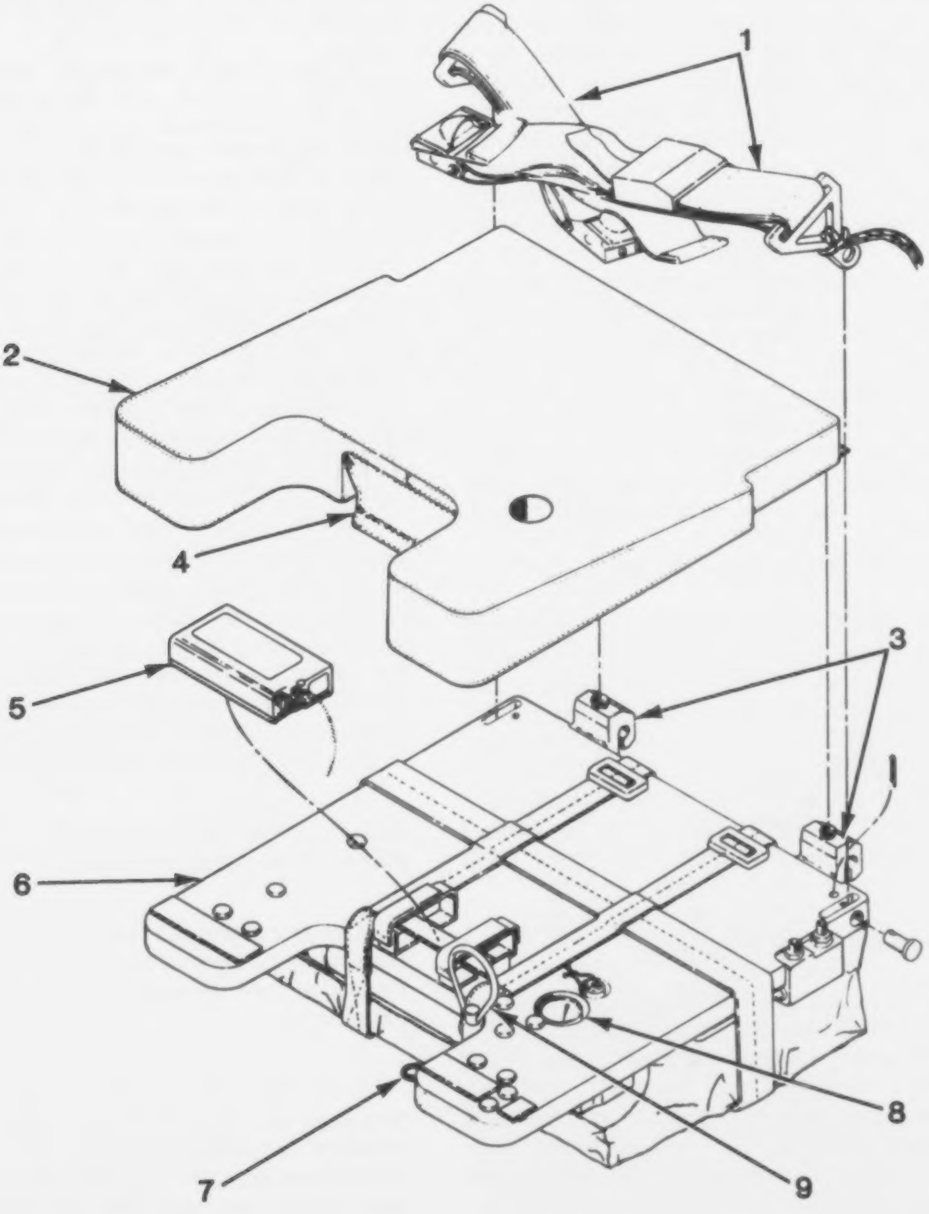
When the main canopy and suspension lines are fully deployed, the spreading-gun firing lanyard exerts tension on a spring-loaded firing pin in the ballistic spreading-gun assembly. This pin is withdrawn until the pin-locking balls slip into a groove in the gun housing. Then, the firing pin, driven by spring force, releases, strikes, and fires dual primers that ignite the spreading gun cartridge. Cartridge energy drives 14 pistons (attached to alternate suspension lines) which expel 14 slugs in a 360-degree pattern and spread the main canopy. Should the spreading gun cartridge fail to fire, continued tension on the firing lanyard removes a piston-retaining band. This frees the slugs from the spreading-gun housing to allow conventional canopy inflation.

During main canopy deployment, tension is exerted on the pilot chute and main canopy by the WORD bridle. Also, during this time, the override and disconnect will secure the WORD bridle to the parachute. If there is no tension on the WORD bridle and the chute has over 10 pounds of drag, the override and disconnect will function to jettison the drogue chute, drogue bridle, WORD motor, and WORD bridle.

Seat Occupant and Survival Kit Release Sequencing Subsystem

The seat occupant and survival kit release sequencing subsystem has four functions. These functions are described in the following paragraphs.

AUTOMATIC RELEASE.—As the personnel parachute inflates during the ejection sequence, the parachute risers pull on the seat and man release lanyards. The lanyards rotate the seat pan release rod and fire the seat and man separation initiator. Gas pressure from the initiator then actuates the inertia reel strap guillotine. Gas is also transmitted to the WORD motor and drogue release assembly and parachute container opener, but these devices will have previously operated. Rotation of the seat release shaft releases the seat pan with the attached survival kit.



1. Lap belt assembly
2. Bottom cushion assembly
3. Aft hooks
4. FOD flap
5. Radio beacon assembly
6. Survival package assembly
7. Emergency oxygen and personnel locator beacon lanyard
8. Emergency oxygen pressure gage
9. Manual emergency oxygen control handle

214.196

Figure 3-15.—Survival kit assembly.

MANUAL OVERRIDE RELEASE.—The pilot can override any of the post-ejection sequences by actuating the emergency release control. When it is actuated, a mechanical linkage fires the seat and man separation initiator. This directs ballistic gas to the inertia reel strap guillotine, which severs the two straps. With the straps severed, the pilot's upper torso restraint is released. Ballistic gas also shuttles the WORD motor, drogue release assembly, and the parachute container opener assembly. The personnel parachute assembly is then deployed by the drogue or the WORD motor, depending upon the airspeed at the time of manual override initiation.

GROUND EMERGENCY EGRESS.—When the emergency release control is pulled, it rotates the seat release shaft and releases the seat pan with attached survival gear from the seat. The control also operates the linkage that fires the seat and man separation initiator. Initiator gases actuate the inertia reel strap guillotine, which severs the straps that are sewn to the personnel parachute risers. The pilot can then remove the shoulder harness, stand, and exit from the aircraft without parachute hang-up. As the pilot stands, the seat pan moves unrestrained and personnel service leads pull free from their connections. Also, activation of the seat and man separation initiator ballistically releases the WORD and drogue release and parachute container opener.

ROUTINE MAINTENANCE.—With the safe and arm control in the UP position and maintenance safety streamer safety pins installed, you must pull the emergency release control to remove the survival kit from the seat for replacement or maintenance.

Survival Kit

The survival kit is a post-ejection life support unit also serving as a structural portion of the ejection seat. (See figure 3-15.) There are three distinct components in the kit: the seat pan, survival package, and emergency oxygen supply.

The seat pan, constructed of a honeycomb core with aluminum alloy face sheets, performs a dual function. First, it provides a base for attaching post-ejection life support equipment. Secondly, it provides a structurally secure attachment for the pilot's lower torso restraint belts.

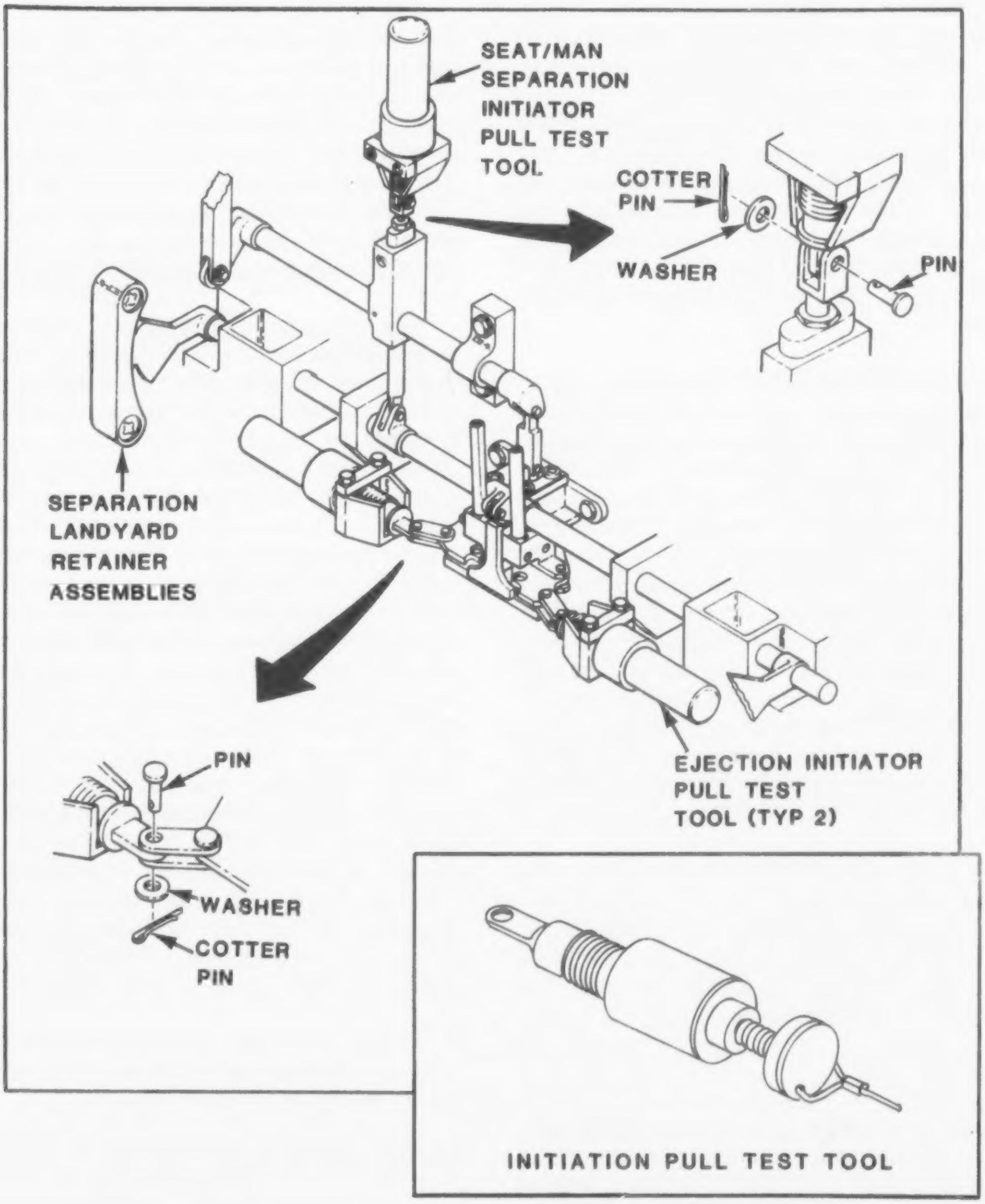
The survival package is attached to the seat pan through a lanyard system. This allows the package to fall free of the seat pan and still remain near the pilot. Upon manual release, the survival package falls approximately 12 feet. It is then snubbbed by a lanyard which inflates the life raft. The package then falls 13 feet below the raft. This stabilizes the raft during parachute descent. The survival package contains a life raft, signal devices, medical aids, and miscellaneous survival aids.

The emergency oxygen supply, attached to the seat pan bottom, is a self-contained unit which can provide 50 cubic inches of breathing oxygen. It can be operated either automatically (during ejection) or manually. Automatic emergency oxygen control is provided by a lanyard assembly located on the underside of the seat pan left thigh support and is connected to the catapult cartridge manifold. During ejection, upward movement of the seat provides automatic actuation. Manual emergency oxygen control is provided by a handle and pull ring located on the inboard side of the seat pan left thigh support. An upward pull on the handle provides emergency oxygen to the pilot should the aircraft's main oxygen system fail. A pressure gage, visible through a cutout on the forward left-hand side of the survival kit assembly, should indicate 1,800 psi (needle in the black area) with a full bottle. The emergency oxygen supply should last approximately 15 minutes, depending upon altitude and pilot demand. The higher the altitude, the shorter the duration, because oxygen is delivered by the mask regulator under pressure upon demand.

NOTE: Automatic actuation of the emergency oxygen supply also provides automatic actuation of the emergency locator beacon.

COMPONENT MAINTENANCE

Since the seat assembly is designed for one-shot operation, it cannot be operationally checked as a unit. However, various components that contribute to the successful functioning of the seat assembly must be operationally checked and tested.


SEAT/MAN SEPARATION INITIATOR PULL TEST TOOL
COTTER PIN
WASHER
PIN
SEPARATION LANDYARD RETAINER ASSEMBLIES
PIN
WASHER
COTTER PIN
EJECTION INITIATOR PULL TEST TOOL (TYP 2)
INITIATION PULL TEST TOOL

214.197

Figure 3-16.—Initiation pull-test tools installation.

It is your responsibility to check, test, and adjust ejection seat components as well as remove and replace cartridges. If you use the applicable maintenance instructions manuals, which contain the procedures for testing, adjusting, and checking components, along with diagrams, drawings, and trouble-shooting charts, you will be able to maintain the ejection seat properly and safely.

NOTE: The following material contains only typical maintenance practices and must not be used during actual component repair and tests. Use only the information contained in the applicable maintenance instruction manual.

There are several procedural checks that may be performed on the Stencel ejection seat. For each of these checks, you should ensure that the safe and arm control is in the SAFE (up and locked) position and that all three maintenance safety streamer safety pins are installed prior to beginning the tests. Most of the checks require that you remove the survival kit and wedge assemblies prior to starting the test and reinstall them at the completion of the test. This is not required for the height adjustment actuator check-out. When you are performing several checks in succession, you do not need to remove and reinstall the survival kit and wedge assemblies between each test.

Safe and Arm Control Assembly Check-out

The individual actions required to check-out the safe and arm control assembly may be grouped into 11 major steps.

1. Install the initiator pull test tool set as shown in figure 3-16.

2. Manually release the safe and arm control assembly release. You should ensure that spring tension is evident in the release knob. Then, you should lower the safe and arm control to the full DOWN position.

3. Attach a push-pull gage to the safe and arm control assembly and then pull upward. The handle should move upward and lock in the SAFE (full up) position with a maximum force of 10 pounds with no evidence of binding. You should observe the outboard bell crank rotate downward, disengaging the upper and lower connect and disconnect sears. Also observe that the inboard bell crank rotates upward to fully engage the safety plunger between the initiator rotors.

4. Raise the emergency release handle to the UP and LOCKED position. You should not see movement of the upper connect and disconnect sear; however, the lower connect and disconnect sear should move down. You should check to see that the T-bar blocks the initiation rotors.

5. Lower the emergency release handle to the full DOWN position. You should see the bell crank connected to the lower sear rotating upward, the initiation subsystem rotors not moving, and the T-bar moving down.

6. Observe that the initiation rotors do not move when you pull on the ejection control handle.

7. Lower the safe and arm control assembly to the full DOWN position. You should ensure the safe and arm control moves to the DOWN position with no evidence of binding, and the inboard bell crank moves downward and completely disengages the safety plunger from the rotors.

8. Raise the safe and arm control assembly to the full UP position. You should ensure that the safe and arm control is locked into position.

9. Lower the safe and arm control assembly to the full DOWN position. The emergency release handle is raised to the UP and LOCKED position. You should observe that the upper sear moves down and the pull-test tool extends to the RELAXED position.

10. Lower the emergency release handle to the DOWN and LOCKED position. When you pull up on the ejection control handle, you can observe that the initiation rotors move and the pull-test tool extends to the relaxed position.

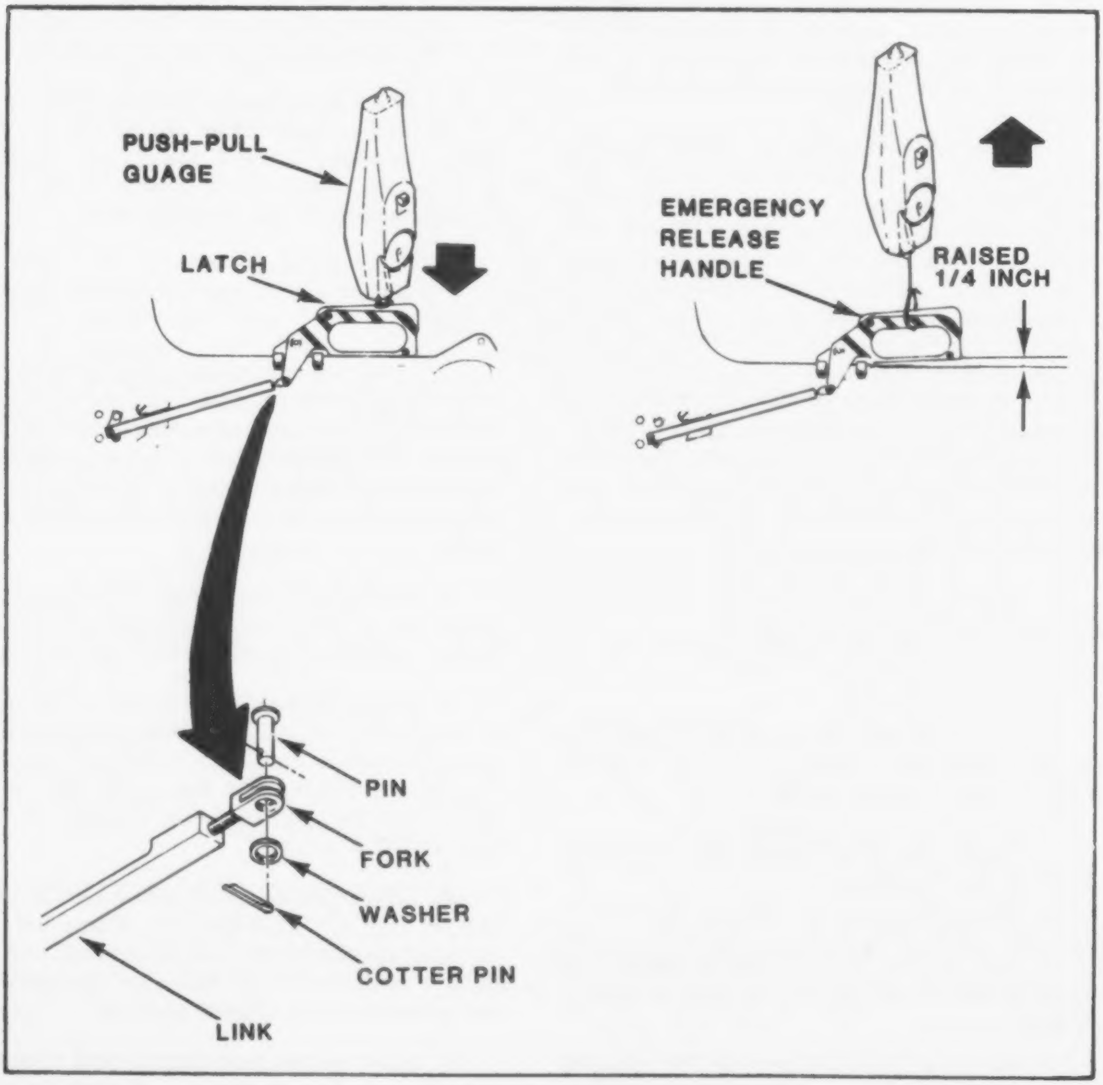
11. Stow the ejection control and reset the pull-test tools. You should raise the safe and arm control to the full UP position. Then, you remove the initiation pull-test tool set.

Emergency Release Handle Assembly Check

The emergency release handle assembly check-out may be divided into nine major steps. Portions of the test are shown in figures 3-17 and 3-18.

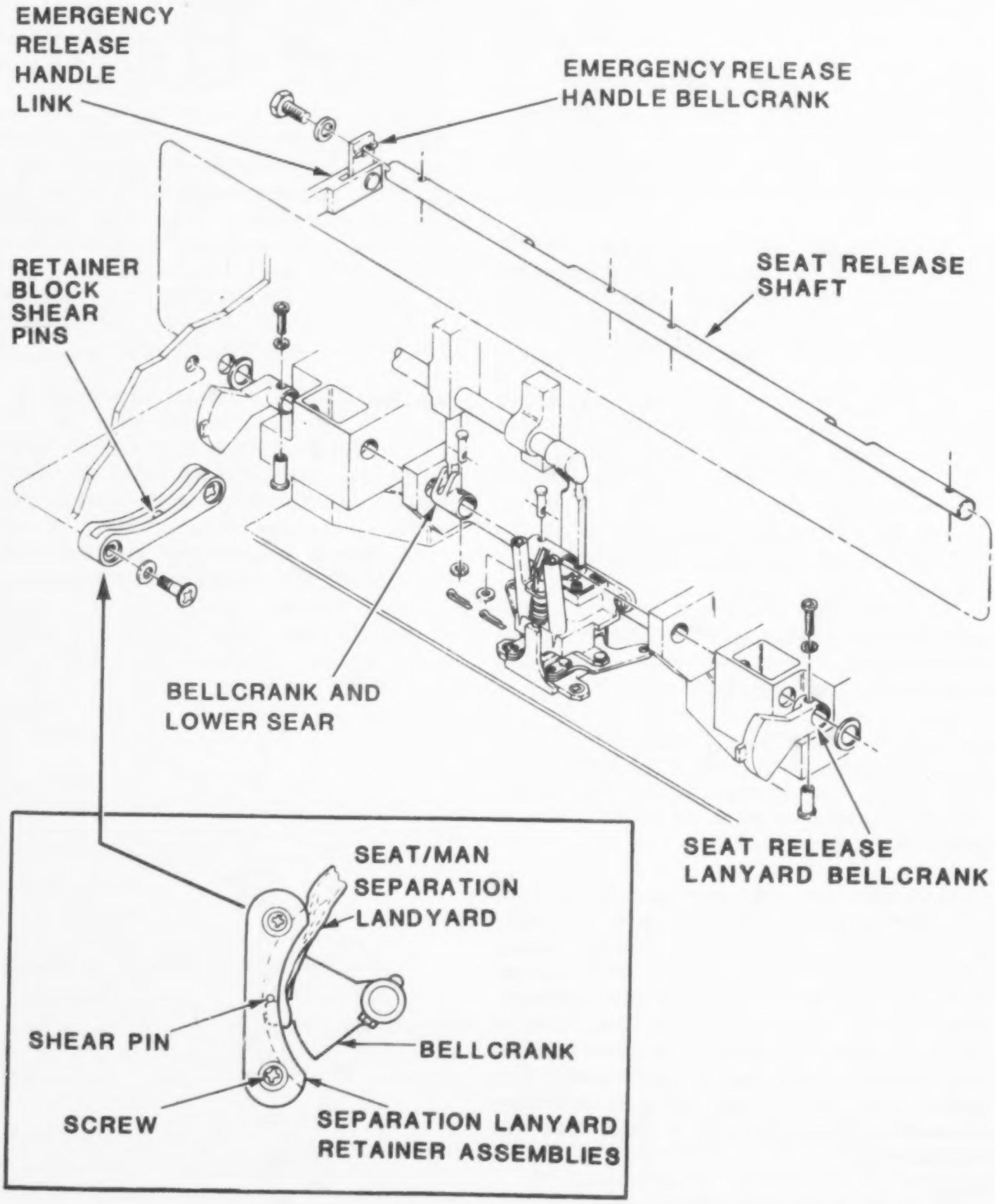
1. Install the initiation pull-test tool set. Lower the emergency release handle and the safe and arm control to the DOWN and LOCKED position. Position the push-pull gage against the top of the emergency release handle and press down on the latch. You should be able to retract the latch with a maximum of 15 pounds of force.

2. Depress the locking latch and raise the emergency release handle 1/4 inch. Attach a push-pull gage and lanyard to the emergency release


PUSH-PULL GUAGE
LATCH
EMERGENCY RELEASE HANDLE
RAISED 1/4 INCH
PIN
FORK
WASHER
COTTER PIN
LINK

214.198

Figure 3-17.—Emergency release handle assembly check-out.


EMERGENCY RELEASE HANDLE LINK
EMERGENCY RELEASE HANDLE BELLCRANK
RETAINER BLOCK SHEAR PINS
SEAT RELEASE SHAFT
BELLCRANK AND LOWER SEAR
SEAT RELEASE LANYARD BELLCRANK
SEAT/MAN SEPARATION LANDYARD
SHEAR PIN
BELLCRANK
SCREW
SEPARATION LANYARD RETAINER ASSEMBLIES

214.199

Figure 3-18.—Separation lanyard retainer assemblies.

handle and pull up and aft. The handle should rotate fully with a maximum force of 40 pounds. You should also notice that seat release shaft rotation actuates the seat and man separation sear, and the pull-test tool extends to the relaxed position. Check to see that the T-bar blocks the firing control rotors, and the emergency release handle is locked in the UP position.

3. Lower the emergency release handle to the full DOWN and LOCKED position. Watch the seat and man separation sear return to the ARM position and the T-bar disengage from the firing control rotors.

4. Raise the safe and arm control to the full UP and LOCKED position. Squeeze the emergency release handle and slowly pull up and aft. Notice that the connect and disconnect upper sear does not move. Lower the emergency release handle to the full DOWN and LOCKED position.

5. Grasp the emergency release handle and, without squeezing the handle or releasing the locking latch, pull up on the handle. The handle should not move.

6. Remove the clevis from the fork at the connect and disconnect sear. Remove the top screws and loosen the bottom screws on the lanyard retainer assemblies. Rotate the retainers forward.

7. Lower the safe and arm control to the DOWN and LOCKED position. Simulate a seat and man separation by unlocking the emergency release handle. Pull up on both the seat and man separation lanyards. Observe that the seat release shaft rotates to the released position and the seat and man separation upper sear moves downward. You should also notice that the seat and man separation lanyards release from the bell cranks.

8. Attach the seat release lanyards to the seat release lanyard bell cranks. At this point, make sure that the seat release lanyards are not pinched between the seat release lanyard bell cranks and the slots in the lanyard retainer assemblies. Rotate the seat release lanyard bell cranks down below the shear pins in the lanyard retainer assemblies. You should ensure that the lanyards remain attached to the bell cranks. Rotate the lanyard retainer assemblies up and aft and install the top screws and washers. Tighten the bottom screws in the lanyard assemblies. When you apply light hand pressure, you should observe freedom of movement in the bell cranks.

9. Lower the emergency release handle to the DOWN and LOCKED position. Remove the initiation pull-test tool set.

Ejection Control Assembly Check-out

Checking the ejection control assembly is a four part procedure. The first part of the procedure is shown in figure 3-19.

1. Install the initiation pull-test tool set. Ensure the ejection initiator pull-test tools are not

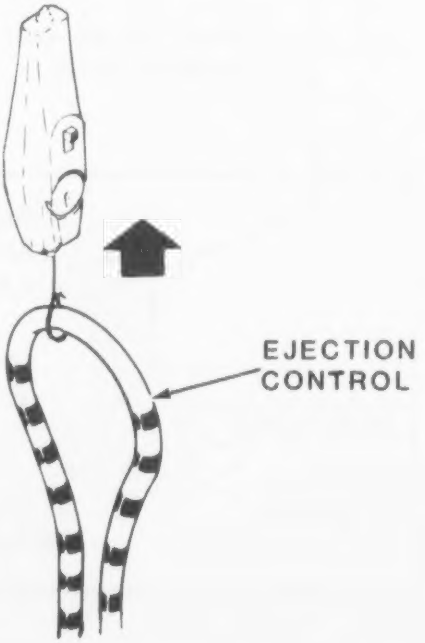


Figure 3-19.—Ejection control assembly check-out.

preloaded. Position the safe and arm control to the full UP position. Attach a push-pull gage to the ejection control assembly. Pull upward and record the breakout force. The breakout force should be 15 to 25 pounds.

2. Lower the safe and arm control to the full DOWN position. Continue pulling upward on the ejection control assembly until the pull-test tools extend to the relaxed position. The force required to accomplish this task should be 15 to 40 pounds. You should ensure that the ejection control assembly does not separate from the seat. You should also observe the initiation rotors rotating past the safety plunger.

3. Stow the ejection control assembly while manually returning the initiation subsystem rotors to the ARMED position. Then install the initiation pull-test tool to the upper connect and disconnect sear. At this point you can simulate automatic seat and man separation by rotating the emergency release handle to the full UP position. Notice that the upper connect and disconnect sear moves down, and the pull-test tool extends to the relaxed position. Check to see that the T-bar is in the full UP position, and that it is blocking the initiation rotors.

4. Raise the safe and arm control to the UP and LOCKED position. Lower the emergency release handle to the DOWN and LOCKED position. Remove the initiation pull-test tool set.

Inertia Reel Assembly Check-out

The inertia reel check-out may be grouped into seven steps. The test is shown in figure 3-20.

1. Insert the bridle rod through both the parachute riser loops. Position the inertia reel manual control to UNLOCK. Then grasp the center of the bridle rod and extend the risers to mid position. Hold the risers extended and position the inertia reel manual control lever to LOCK. When you pull firmly on the center of the bridle rod, the risers should not extend.

2. Slowly allow the risers to retract. The risers retracting and ratcheting action should be audible during retraction. The inertia reel control lever should not snap into position, or the test results will not be valid.

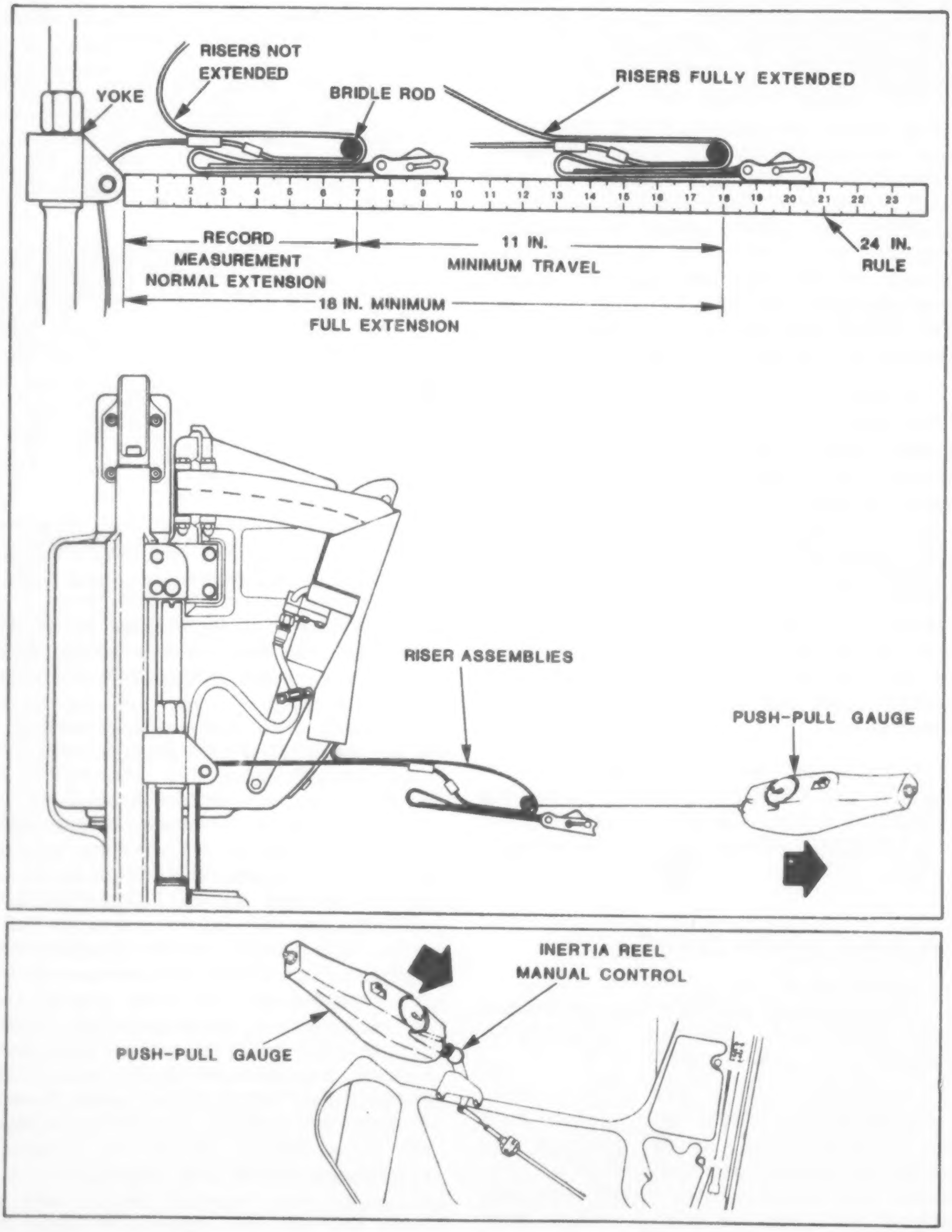
3. Slowly position the inertia reel manual control lever to UNLOCK. Grasp the center of the bridle rod and extend both risers to the mid position. Exert a sharp pull on the bridle rod. The inertia reel should lock and the risers should not extend when a firm pull is applied. Slowly allow the risers to fully retract and then pull the risers again. You should not be able to extend the risers.

4. Position the lever to LOCK, then UNLOCK and extend and retract the risers. The risers should extend and retract freely.

5. Attach a push-pull gage to the bridle rod. Pull the gage straight and extend the risers. You should record the force required to extend them. Repeat the step three to five times. The risers should extend with a force of 5 to 15 pounds. Allow the riser to retract slowly.

6. Position a 24-inch steel rule against the forward edge of the yoke and perpendicular to the catapult tubes. Without extending the inertia reel straps, lift the bridle rod and measure the normal extension of the risers. You should record this measurement. Pull on the bridle rod and measure the full extension of the risers. Again, record the measurement. Allow the risers to retract slowly. At full extension, you should observe a minimum of 18 inches. Then, subtract the normal measurement from the extended measurement. The difference between the measurements should be a minimum of 11 inches of total riser travel.

7. Position the inertia reel control to LOCK. Attach a spring scale to the center


RISERS NOT EXTENDED
YOKE
BRIDLE ROD
RISERS FULLY EXTENDED
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
RECORD MEASUREMENT NORMAL EXTENSION
11 IN. MINIMUM TRAVEL
24 IN. RULE
18 IN. MINIMUM FULL EXTENSION
RISER ASSEMBLIES
PUSH-PULL GAUGE
INERTIA REEL MANUAL CONTROL
PUSH-PULL GAUGE

214.200

Figure 3-20.—Inertia reel assembly check-out.

of the bridle rod. Position a push-pull gage against the forward edge of the control knob parallel to the seat side panel. Apply a 50-pound pull to the bridle rod and maintain this tension while applying a push force to the control knob. The control knob should move, without binding, to the aft position with a maximum of 25 pounds of force. Allow the risers to completely retract and remove the spring scale and bridle rod.

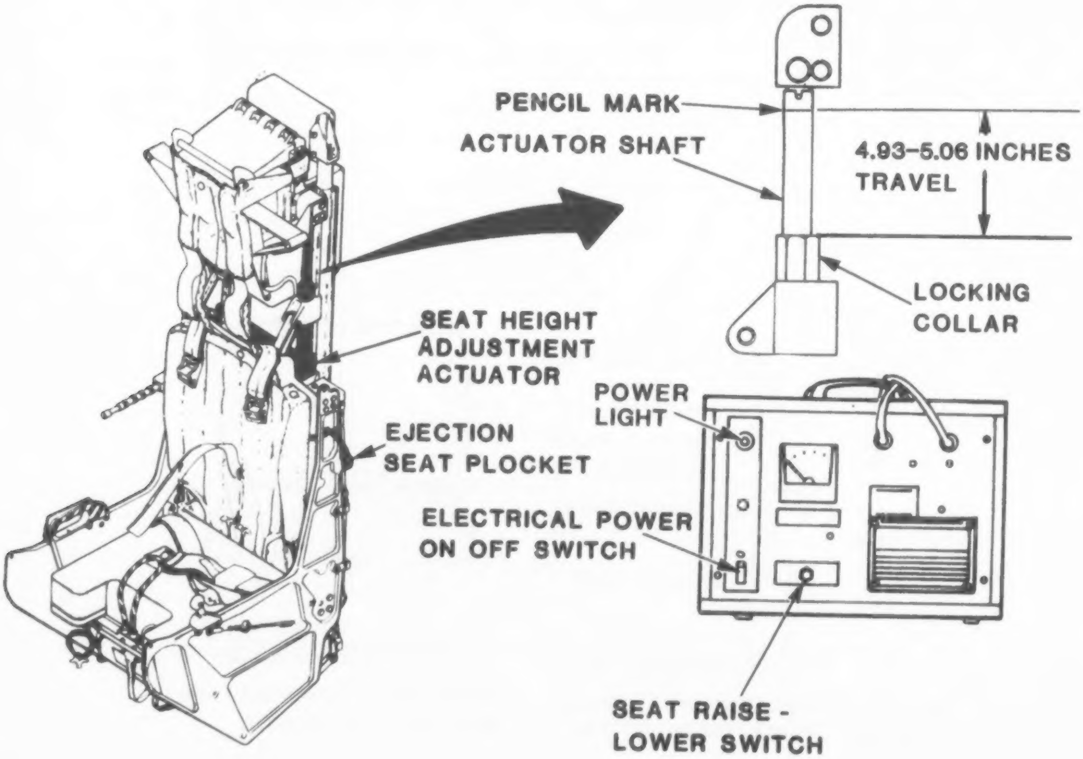
Height Adjustment Actuator Check-out

Removal of the wedge and survival kit assemblies is not required to complete the five steps of the height adjustment actuator check-out. Portions of this test are shown in figure 3-21.

1. Attach a control tester to the plocket on the left side of the seat. You should ensure that the tester power switch is OFF and the raise-lower switch is in the mid position. Connect the tester electrical plug to a 115-volt ac, 60 Hz, single phase power source and position the power switch to ON.

CAUTION: To prevent damage to the height adjustment actuator motor because of overheating, the operating time limit of 30 seconds on and 1 minute off must be observed.

2. Position the raise-lower switch to RAISE and hold it in that position. You should observe the current indicated on the control tester ammeter while the seat travels to the full UP position. The maximum start current should be 15 amps and the maximum run current should be 5 amps.
3. Release the raise-lower switch and place a pencil mark on the actuator shaft at the locking collar. Now, move the raise-lower switch to LOWER and hold it in that position. Again, you should observe the current indicated on the


PENCIL MARK
ACTUATOR SHAFT
4.93–5.06 INCHES TRAVEL
LOCKING COLLAR
SEAT HEIGHT ADJUSTMENT ACTUATOR
POWER LIGHT
EJECTION SEAT PLOCKET
ELECTRICAL POWER ON OFF SWITCH
SEAT RAISE - LOWER SWITCH

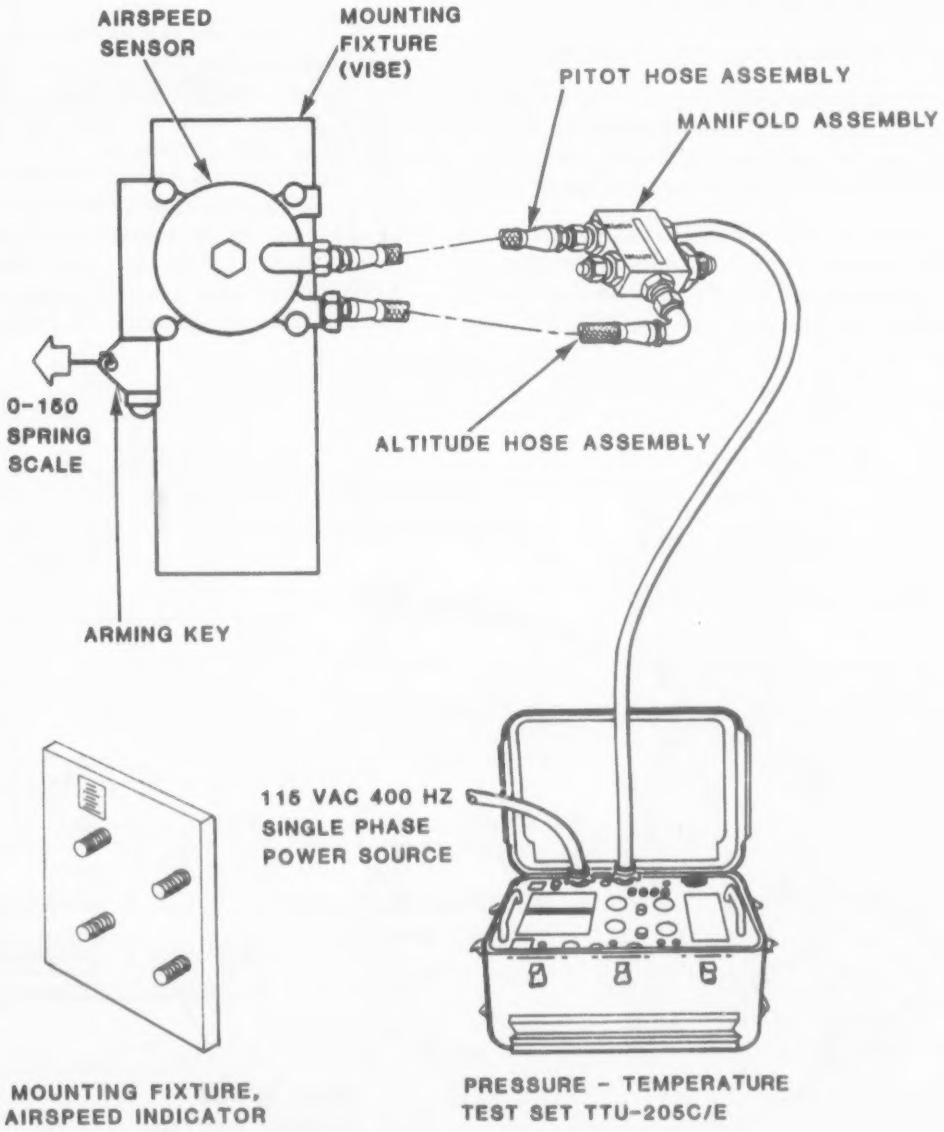
214.201

Figure 3-21.—Seat height adjustment actuator check-out.

control tester ammeter while the seat travels to the full DOWN position. You should notice no binding while the seat is traveling. The start and run current requirements are the same as in the previous step.

4. Release the raise-lower switch. At this time, you should measure and record the distance from the pencil mark on the actuator shaft to the upper edge of the locking collar. For the test results to be acceptable, the difference between the measurements should be 4.93 to 5.06 inches of total actuator shaft travel.

5. Raise the seat bucket to the mid-travel position. Position the power switch to OFF.


AIRSPEED SENSOR
MOUNTING FIXTURE (VISE)
PITOT HOSE ASSEMBLY
MANIFOLD ASSEMBLY
0-150 SPRING SCALE
ALTITUDE HOSE ASSEMBLY
ARMING KEY
115 VAC 400 HZ SINGLE PHASE POWER SOURCE
MOUNTING FIXTURE, AIRSPEED INDICATOR
PRESSURE - TEMPERATURE TEST SET TTU-205C/E

214.202

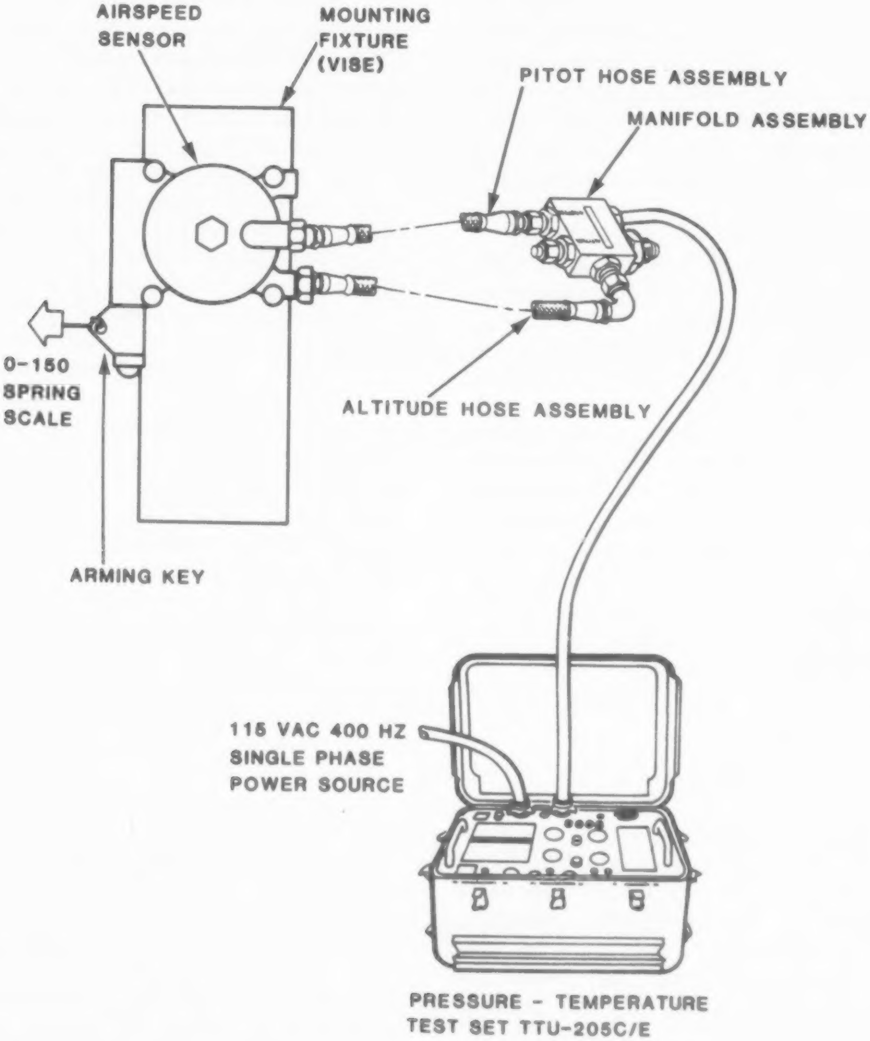
Figure 3-22.—Airspeed/Altitude sensor functional check setup.

Disconnect the tester electrical plug from the power source and disconnect the tester electrical plocket from the seat.

Airspeed/Altitude Sensor Check-out

The airspeed/altitude sensor (A/AS) must be removed from the aircraft to perform the check-out procedure. The following paragraphs describe the steps of the test procedure. Figures 3-22 and 3-23 portray portions of the test.

1. Place the A/AS in the mounting fixture and secure them to the work bench. Screw the pitot hose from the manifold assembly onto the pressure port of the A/AS. After you remove the static port filter, screw the altitude hose from the manifold assembly into the static port of the


AIRSPEED SENSOR
MOUNTING FIXTURE (VISE)
PITOT HOSE ASSEMBLY
MANIFOLD ASSEMBLY
0-150 SPRING SCALE
ALTITUDE HOSE ASSEMBLY
ARMING KEY
115 VAC 400 HZ SINGLE PHASE POWER SOURCE
PRESSURE - TEMPERATURE TEST SET TTU-205C/E

214.203

Figure 3-23.—Airspeed/Altitude sensor function check setup.

A/AS. Then connect the pitot pressure hose of the test set to the airspeed port of the manifold assembly. Set the pressure temperature test set controls to the positions listed in table 3-1.

WARNING: The TTU-205-C/E test set must be properly grounded to prevent injury to personnel.

2. Connect the test set electrical plug to a 115-volt ac, 400 Hz, single phase power source. Set the test set power switch to ON. When the pressure stabilizes, the static pressure ready light and the pitot pressure ready light will illuminate. Rotate the static pressure vent and pitot pressure vent controls full clockwise. Position the airspeed knots control to 500. Vary the airspeed trim control as necessary to obtain 500 on the airspeed knots indicator. It will take a few minutes for the airspeed knots indication to increase to 500.

3. Position the airspeed (A/S) leak test switch to ON. Allow the pitot pressure to stabilize. At this point, you should ensure that the pitot pressure light goes out and that the leak rate is not more than 15 knots in 5 minutes. Position the A/S leak test switch to OFF. The pitot pressure light should illuminate and the airspeed knots should return to 500. Position the airspeed knots control to 280. Vary the airspeed trim control to obtain 280 on the airspeed knots indicator.

WARNING: To prevent injury, make sure personnel are clear of the A/AS plunger during actuation.

4. Attach a 0- to 150-pound spring scale to the arming key. Apply a straight pull on the scale and remove the sensor arming key. The arming key should release between 6 to 16 pounds of force and the sensor plunger should remain extended.

5. Extend the plunger with the pull tool and reinstall the arming key. Position the airspeed knots control to 250 and vary the airspeed trim control to obtain 250 on the airspeed knots indicator. Remove the A/AS arming key and observe the A/AS plunger retract. Again, use the pull tool to extend the plunger and reinstall the arming key.

Table 3-1.—TTU-205-C/E Testor Control Settings

CONTROL	SETTING
POWER	OFF
MODULATION FREQ. HZ	OFF
MODULATION AMPLITUDE	0
MACH LIMIT DISABLE/NORMAL	NORMAL
MACH LIMIT SET	1.5
ALT LEAK TEST	OFF
A/S LEAK TEST	OFF
AIRSPEED KNOTS	50
AIRSPEED RATE/KNOTS/MINUTE	0
AIRSPEED TRIM	CENTERED
ALTITUDE X 1000 FEET	0
ALTITUDE RATE X 1000 FEET/MINUTE	0
ALTITUDE TRIM	CENTERED
ALTITUDE HOLD/NORMAL	NORMAL
TOTAL TEMP: SIMULATE	50.0 OHMS
STATIS PRESSURE VENT	FULL COUNTERCLOCKWISE
PITOT PRESSURE VENT	FULL COUNTERCLOCKWISE
NORMAL/READ EXT.	NORMAL

6. Position the airspeed knots control to 50. After the airspeed knots indication decreases to the set value, position the test set power switch to OFF. Rotate the static pressure vent and pitot pressure vent controls full counterclockwise. Disconnect the test set pitot hose from the manifold and test set. Remove the pitot hose assembly from the airspeed port of the manifold and connect it to the altitude port of the manifold assembly. Plug the airspeed port of the manifold.

7. Rotate the static pressure vent and pitot pressure vent controls full clockwise. Position the test set power switch to ON. Position the ALTITUDE X 1000 FEET control between 7 and 8. The altitude feet indication should increase to approximately 7750. You may have to vary the altitude trim control to obtain 7750 on the altitude feet indicator. Remove the A/AS arming key. The A/AS plunger should remain extended.

8. Use the pull tool to extend the plunger and install the arming key. Set the ALTITUDE X 1000 FEET control between 6 and 7. Vary the altitude trim control to obtain 6250 on the altitude feet indicator. The arming key should release with a pull of 6 to 16 pounds of force and the A/AS plunger should retract.

9. Again, you should use the pull tool to extend the plunger and reinstall the arming key. Position the altitude control to zero. After the altitude feet indication decreases to the set value, position the test set power switch to OFF. Rotate the static pressure vent and pitot pressure vent controls full counterclockwise.

10. Remove the manifold assembly from the A/AS and disconnect it from the test set. Disconnect the static pressure hose from the test set. Disconnect the power source and remove the test set.

If the A/AS passes the functional check, you may install it on the seat. If the A/AS is faulty, you should forward it to depot level maintenance for repair.

Safety Precautions

Safety precautions must be strictly observed when working around aircraft equipped with an ejection seat. These safety precautions cannot be overemphasized. Each ejection seat has several ground safety pins. These safety pins are provided on red-flagged lanyards for use at every point of potential danger. They must be installed whenever the aircraft is on the ground or deck, and they must never be removed until the aircraft is ready for flight.

The following general precautions should always be kept in mind.

1. Ejection seats must be treated with the same respect as a loaded gun.
2. Always consider an ejection seat system as loaded and armed.
3. Before you enter a cockpit, know where the ejection seat safety pins are located and make certain of their installation.
4. Only authorized personnel may work on, remove, or install ejection seats and components, and only in authorized areas.

Supervisors take note. It has been said that nothing is foolproof because fools are so ingenious. Personal safety for those who work around ejection seats cannot be guaranteed; however, a high level of safety can be achieved if personnel have the proper attitude, understanding, training, and adequate supervision. Unless proper maintenance procedures are followed explicitly, even the most routine ejection seat maintenance tasks can grow drastically out of proportion and bring about an accident or injury. Education of the workers involved is the best assurance for personnel safety. The workers should be made aware of potential hazards and the proper means of protecting themselves. Workers should be assigned according to their capabilities.

CORROSION CONTROL

The manufacturers of the Stencel ejection seat have stated that the seat is corrosion resistant. Therefore, on the special 40-day corrosion inspection, the SJU-8/A ejection seat has no inspection requirements. But we know that during shipboard operation, the seat will come in contact with salt spray, jet exhausts, stack gases, and various other debris. Although the seat is not addressed in the 40-day MRCs, it should be maintained in accordance with the NA 01-1A-509 and local squadron instructions. The NA 01-1A-509 states that ejection seats should have a 7-day inspection performed while at sea and a 14-day inspection when ashore.

LUBRICATING PROCEDURES

You should ensure that oils, greases, preservatives, cleaning solutions, and solvents do not enter enclosed mechanisms, cartridge chambers, and ballistic hose and tube assemblies or come in contact with cartridges or initiators. You should cap all open ports during corrosion maintenance. All lubricants must be applied sparingly and you must exercise care to protect nylon and cotton fabrics from contamination. Indiscriminant use of paint and preservatives that dry and build up with repeated or excessive application will often result in restricted movement of parts. This can easily render affected seats useless for ejection purposes.

The following lubricants and procedures should be used on the Stencel ejection seat as stated in the NA 01-1A-509.

1. Lubricating oil, VV-L-800, should be applied to all parts that rotate, such as bell cranks, levers, pins, rollers, and similar components.
2. Grease, MIL-G-81322 or MIL-G-23827, should be applied to all parts that slide and should also be used as a corrosion preventive for all bright metal parts.
3. Apply MIL-C-85054 by brush or swab to all unpainted, nonmoving parts, such as nuts and bolts, that do not require lubrication.
4. Cleaning solvent and lubricants may be applied with brush or cloth providing adequate care is taken to prevent entry into closed mechanisms.
5. Surface contaminants such as dried lubricants, dirt, grit or corrosion products can be removed from intricate bell cranks and levers by scrubbing with a small nylon bristle brush using P-D-680, Type II, cleaning solvent. Follow the cleaning solvent with a light coat of VV-L-800 oil to the entire component or assembly.

EMERGENCY CLEANING

The following emergency cleaning procedures should be used for cleaning ejection seats exposed to gross amounts of salt water or fire extinguishing agents. The procedures described are normally used only to prevent further damage and will usually require further treatment at a higher level of maintenance.

WARNING: Disarm ejection seat mechanisms before cleaning. Only authorized personnel should disarm seats and perform cleaning operations.

1. Remove parachutes, drogue parachutes where applicable, and seat pans. These items should be returned to local work centers for cleaning or replacement.
2. Remove ejection seats according to the applicable maintenance instruction manual.
3. Remove the CADs, rockets, and inertia reels from the seats. Cap all gas lines and ports. Then, wipe down these components with fresh water.
4. Rinse the seat thoroughly with fresh water. Continue washing while directing the water into crevices and close fitting parts until the contaminants are removed.
5. Blow as much water as possible from equipment with low pressure, clean, dry air.
6. Dry excess water deposits with a clean cloth, clean paper towels, or remnant cloths.
7. Apply the water displacing preservative MIL-C-81309, Type II, by spray or brush to critical metal surfaces and to recess areas which may not be completely dry. Water displacing preservative protects equipment during necessary inspection or inquiry, and during transfer to the repair custodian.
8. Wash all survival gear and pilot safety equipment with fresh water and dry thoroughly. You should refer to NAVAIR 13-1-6-X for detailed preservation procedures. Lubricate and control corrosion in accordance with maintenance requirements cards.
9. You should comply with all special inspection requirements before reinstallation. Reassemble ejection seats in accordance with the maintenance instruction manuals.
10. If necessary, send the ejction seat to the next higher level of maintenance.
11. Aircraft mounted escape system components (mechanically activated CADs) should be wiped with fresh water, a cloth, and dried. If external contamination is suspected, these components should be removed and replaced.

CHAPTER 4

AIR-CONDITIONING AND PRESSURIZATION SYSTEMS

AMEs are required to maintain the air-conditioning and pressurization systems of naval aircraft. These systems provide heating and cooling of the cabin and, at altitude, the pressurization required for breathing. As an AME, you will be assisting aircrews and troubleshooting discrepancies. A good knowledge of the systems is necessary to perform effectively. This chapter uses the S-3 environmental control system as the basis for discussion. To simplify matters, we have divided the system into three subsystems: bleed air, air-conditioning, and pressurization. Because many of the valves in this system are electrically actuated and operated, troubleshooting skills involving the use of the multimeter are discussed.

BLEED-AIR SYSTEM

The bleed-air system is the air source for the environmental control system (ECS) and for deicing functions. There are three sources of bleed air available. The primary source is from the compressor sections of the two aircraft engines. Secondary sources are from the auxiliary power unit (APU) on board the aircraft and an external air supply such as ground support equipment (SE).

SYSTEM OPERATION

The source of air for the bleed-air system may be from the aircraft engines, the APU, or SE. Operation of the system using each of these sources is presented in the following paragraphs. Frequent referral to the bleed-air system schematic (figure 4-1) will aid you in understanding the material.

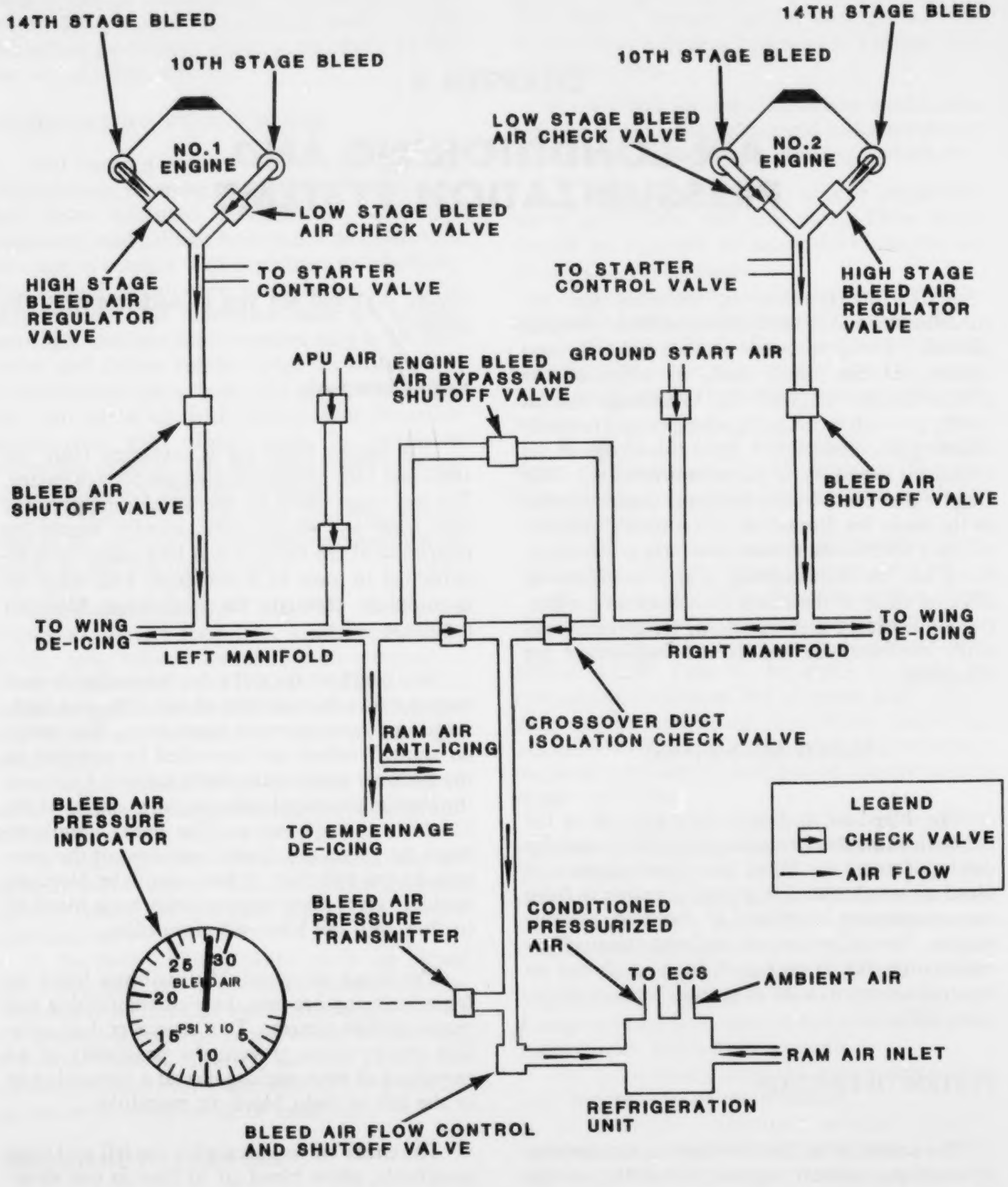
Engine Bleed Air

The engine bleed air is extracted from the 10th- and 14th-compression stages of each engine. The low-stage bleed-air check valve supplies the 10th-stage air, which is the primary source for operation of the ECS. When 10th-stage air is insufficient to meet ECS demands, 14th-stage air is supplied through the high-stage bleed-air regulator valve.

One bleed-air shutoff valve is installed in each engine pylon downstream of the 10th- and 14th-stage engine-compressor bleed ports. The bleed-air shutoff valves are controlled by switches on the eyebrow panel in the flight station. Lights on the instrument panel indicate the position of the bleed-air shutoff valves. The lights illuminate when the valves are closed regardless of the position of the switches. When open, the bleed-air shutoff valves allow engine compressor bleed air to flow into the bleed-air manifolds.

The bleed-air manifold distributes bleed air from both engines into the air-conditioning and pressurization systems. Two crossover duct isolation check valves prevent the possibility of an overbleed of both engines should a rupture occur in the left or right bleed-air manifold.

The check valves, located in the left and right manifolds, allow bleed air to flow in one direction only. If the left or right engine bleed air is secured, or if a rupture occurs in the left or right bleed-air manifold, the appropriate check valve


14TH STAGE BLEED
10TH STAGE BLEED
NO.1 ENGINE
LOW STAGE BLEED AIR CHECK VALVE
HIGH STAGE BLEED AIR REGULATOR VALVE
TO STARTER CONTROL VALVE
14TH STAGE BLEED
10TH STAGE BLEED
LOW STAGE BLEED AIR CHECK VALVE
NO.2 ENGINE
TO STARTER CONTROL VALVE
HIGH STAGE BLEED AIR REGULATOR VALVE
APU AIR
ENGINE BLEED AIR BYPASS AND SHUTOFF VALVE
GROUND START AIR
BLEED AIR SHUTOFF VALVE
BLEED AIR SHUTOFF VALVE
TO WING DE-ICING
LEFT MANIFOLD
RIGHT MANIFOLD
TO WING DE-ICING
CROSSOVER DUCT ISOLATION CHECK VALVE
RAM AIR ANTI-ICING
TO EMPENNAGE DE-ICING
BLEED AIR PRESSURE INDICATOR
LEGEND
CHECK VALVE
AIR FLOW
BLEED AIR PRESSURE TRANSMITTER
CONDITIONED PRESSURIZED AIR
TO ECS
AMBIENT AIR
25
30
BLEED AIR
20
PSI X 10
15
5
10
RAM AIR INLET
REFRIGERATION UNIT
BLEED AIR FLOW CONTROL AND SHUTOFF VALVE

214.146

Figure 4-1.—Bleed-air system schematic.

closes. This allows the air-conditioning and pressurization subsystems to operate from the opposite bleed-air source. An open engine bleed-air bypass and shutoff valve allows bleed air to bypass the check valves and flow from the left-to-right or right-to-left manifolds. The engine bleed-air bypass and shutoff valve is open during engine starting. It is also open when operating the deicing system with one engine secured.

Bleed-air pressure is sensed by the bleed-air pressure transmitter located in the bleed-air supply duct downstream of the crossover duct isolation check valves. The pressure is displayed on the bleed-air pressure indicator on the environmental panel.

Bleed air from the left and right manifolds flows through the crossover duct isolation check valves to the bleed-air flow control and shutoff valve. The bleed-air flow control and shutoff valve is electrically controlled and pneumatically actuated to modulate the bleed-air flow to the air-conditioning and pressurization systems in response to predetermined flow schedules.

Two alternate air supply sources, APU air and ground start air, connect to the left and right bleed air manifold. The APU air duct supplies bleed air through two check valves to the left manifold. The ground start duct supplies high-pressure air through a check valve to the right manifold. These alternate air supply sources are used primarily for starting engines and for ground operation of the air-conditioning system.

APU Bleed Air

Bleed air flows from the APU compressor through two one-way check valves in the APU duct to the left one-way check valve in the crossbleed manifold. Bleed air is also supplied to the bleed-air shutoff valve, the left side of the engine bleed-air bypass and shutoff valve, empennage deice valve, the left wing deice valve, and the ram air anti-icing valve. With the bleed air switch in the ON position, the left bleed-air shutoff valve is opened. In the open position, bleed air is supplied to the left engine starter control valve. To provide bleed air to the right side of the crossbleed manifold, the engine bleed-air bypass and shutoff valve is opened to allow bleed air to the right bleed-air shutoff valve and to the right wing deice valve. With the bleed air engine number 2 switch set to ON, the right bleed-air shutoff valve is opened. In the open position, bleed air is supplied to the right engine starter-control valve.

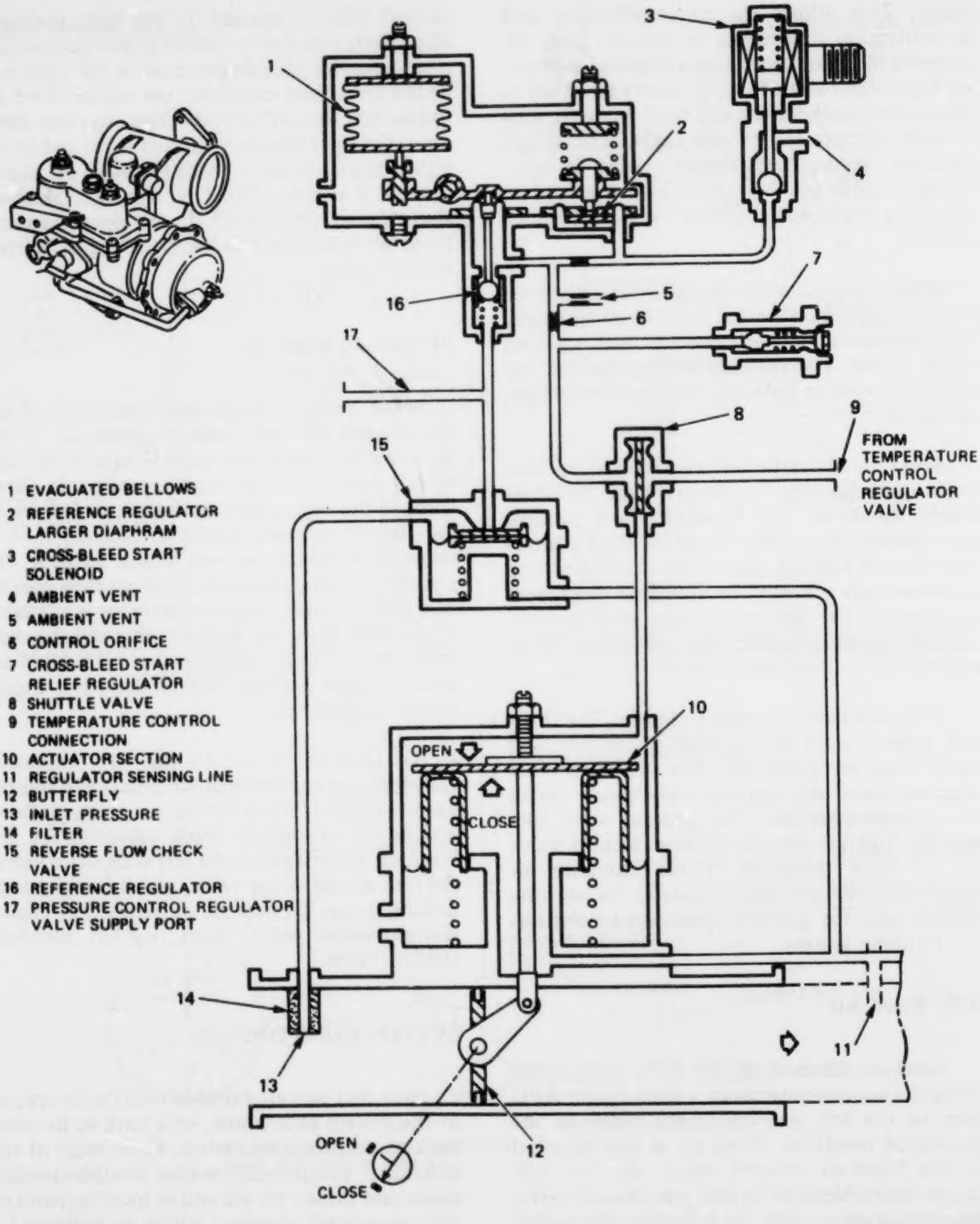
SE Ground Start Air

When support equipment is the source of air, the ground air start hose is connected to the ground start connection nipple located in the right wheel well. External high-pressure air flows through the engine starting duct check valve into the right crossbleed manifold. Normal flow is through the right one-way check valve in the crossbleed manifold to the bleed-air flow control and shutoff valve. High-pressure air is available to the right bleed-air shutoff valve and the right wing deice valve. Opening the right bleed-air shutoff valve provides air to the right engine starter control valve.

To provide SE air to the left crossbleed manifold, the engine bleed-air bypass and shutoff valve is opened. When the valve is open, air flows around the crossbleed check valves to the left bleed-air shutoff valve, the left wing deice valve, the ram air anti-icing valve, and the empennage deicing valve. To provide air to the left engine starter-control valve, open the left bleed-air shutoff valve.

SYSTEM COMPONENTS

Now that you are familiar with the operation of the system as a whole, let's look at its components and their operation. Knowledge of the individual components makes troubleshooting easier and faster. To aid you in locating parts of the components, numbers within parentheses ( ) are included which correlate to the numbers on the illustrations.


3
1
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16
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17
8
9
FROM
TEMPERATURE
CONTROL
REGULATOR
VALVE
15
10
OPEN
CLOSE
14
11
13
12
OPEN
CLOSE

1 EVACUATED BELLOWS
2 REFERENCE REGULATOR LARGER DIAPHRAM
3 CROSS-BLEED START SOLENOID
4 AMBIENT VENT
5 AMBIENT VENT
6 CONTROL ORIFICE
7 CROSS-BLEED START RELIEF REGULATOR
8 SHUTTLE VALVE
9 TEMPERATURE CONTROL CONNECTION
10 ACTUATOR SECTION
11 REGULATOR SENSING LINE
12 BUTTERFLY
13 INLET PRESSURE
14 FILTER
15 REVERSE FLOW CHECK VALVE
16 REFERENCE REGULATOR
17 PRESSURE CONTROL REGULATOR VALVE SUPPLY PORT

214.147

Figure 4-2.—High-stage bleed-air regulator valve schematic.

High-Stage Bleed-Air Regulator Valve

The high-stage bleed-air regulator valve is a normally closed, differential-pressure regulator. (See figure 4-2.) Air from the inlet (13) passes through the filter (14) and then through the reverse-flow check valve (15). The air then enters the reference regulator (16) where it is pressure regulated as a function of altitude by an evacuated bellows (1). The air is then passed through a control orifice (6), a shuttle valve (8), and to the actuator section (10) of the high-stage bleed-air regulator valve to open the butterfly (12). The pressure of the air entering the regulator sensing line (11) with the spring pressure of the actuator section (10) of the valve modulates the valve toward the closed position as regulated by pressure from the shuttle valve. As aircraft altitude increases, the evacuated bellows (1) expand and cause the reference regulator (16) to close. The ambient vent (5) decreases the pressure to the open side of the actuator section (10) and thereby allows the spring to close the actuator section (10). This action also closes the butterfly (12).

When the crossbleed start solenoid (3) is energized, the reference regulator larger diaphragm (2) is vented to ambient (4). Spring pressure on the reference regulator larger diaphragm (2) causes the reference regulator (16) to open. This results in pressure being passed through the control orifice (6), which is regulated by the crossbleed start relief regulator (7). The pressure commands the actuator section (10) to open with a corresponding opening of the butterfly (12).

During deicing operations, control pressure from the temperature control regulator valve is applied to the temperature control connection (9). This changes the shuttle valve (8) position to allow the temperature control regulator valve pressure to open the actuator section (10) and the butterfly. During deicing operations, pressure from the temperature control regulator valve overrides all other inputs to the shuttle valve.

Bleed-Air Shutoff Valve

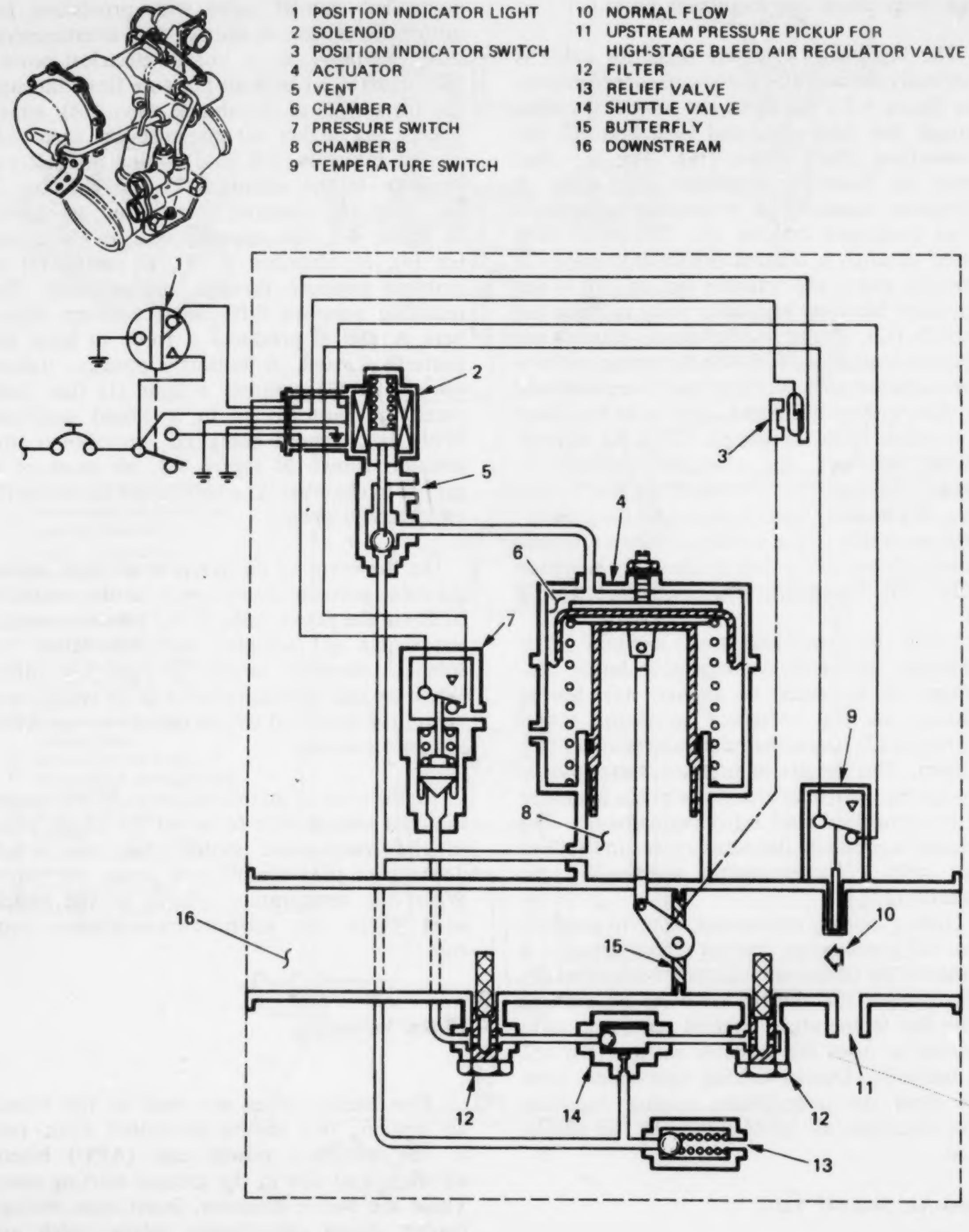
The bleed-air shutoff valve is a normally closed, pneumatically operated, electrically controlled shutoff valve with provisions for automatic closure in the event of overtemperature, overpressure, or loss of electrical power. (See figure 4-3.) Inlet air pressure flows through the filters (12) to the shuttle valve (14), which selects the higher air pressure on each side of the butterfly (15) and routes the selected pressure to the solenoid (2) and chamber B (8). With the solenoid deenergized, as shown in figure 4-3, the opening side of the actuator (4), or chamber A (6), is vented (5) to ambient pressure through the solenoid. The resulting pressure differential between chambers A and B produces a force to keep the butterfly closed. A butterfly position indicator switch (3) controls a light (1) that indicates the butterfly is in a closed position. With the solenoid energized, opposite to the position shown in figure 4-3, air pressure is ported to chamber A, which opens the butterfly and keeps it open.

In the event of an overpressure that causes the inlet pressure downstream of the butterfly to attain the preset value of the pressure switch, the switch (7) actuates and deenergizes the solenoid electrical circuit to close the valve. When the inlet pressure returns to the switch reset value, the electrical circuit closes to reestablish solenoid control.

In the event of an overtemperature that causes the inlet temperature to attain the preset value of the temperature switch (10), the switch deenergizes the solenoid and closes the valve. When the temperature returns to the switch reset value, the solenoid reestablishes control.

Check Valves

Five check valves are used in the bleed-air system: two in the crossbleed duct, two in the auxiliary power unit (APU) bleed-air duct, and one in the ground starting duct. These are 3-inch diameter, insert-type, spring-loaded closed split-flapper valves which are designed to be inserted into, and contained by, the aircraft duct.



1 POSITION INDICATOR LIGHT
2 SOLENOID
3 POSITION INDICATOR SWITCH
4 ACTUATOR
5 VENT
6 CHAMBER A
7 PRESSURE SWITCH
8 CHAMBER B
9 TEMPERATURE SWITCH
10 NORMAL FLOW
11 UPSTREAM PRESSURE PICKUP FOR HIGH-STAGE BLEED AIR REGULATOR VALVE
12 FILTER
13 RELIEF VALVE
14 SHUTTLE VALVE
15 BUTTERFLY
16 DOWNSTREAM

214.148

Figure 4-3.—Bleed-air shutoff valve schematic.

Low-Stage Bleed-Air Check Valve

The low-stage bleed-air check valve is installed in the engine pylon bleed-air duct on the right side of the engine. The low-stage bleed-air check valve allows bleed air from the 10th-stage engine compressor to enter the bleed-air subsystem to protect the engine when high-stage bleed air is scheduled.

The low-stage bleed-air check valve consists of a main housing and two semicircular flappers hinged on a post positioned radially through the center of the housing. The low-stage bleed-air check valve permits flow in the direction indicated by the arrow, and restricts flow in the opposite direction. The flappers are spring-loaded in the closed position.

Engine Bleed-Air Bypass and Shutoff Valve

The engine bleed-air bypass and shutoff valve, located in the crossbleed manifold, is normally closed. It is open for engine starting and during single-engine wing-deicing operations. (See figure 4-4.) When the solenoid (1) is energized, the shuttle valve (7) senses the higher pressure air from the right and left pressure inlets (3 and 5) and directs it through the solenoid to chamber A (6) to open the butterfly (4). When the solenoid is deenergized, air bypasses the solenoid and enters chamber B (2) to assist the spring in closing the engine bleed-air bypass and shutoff valve.

Bleed-Air Flow Control and Shutoff Valve

The bleed-air flow control and shutoff valve is a normally closed valve with two flow schedules: fixed and inlet pressure regulated. (See figure 4-5.) The valve is electropneumatically controlled and pneumatically actuated.

The venturi inlet (17) and throat pressure (18) are routed to the delta-P servo diaphragm (22). As the inlet pressure to the bleed-air flow control and shutoff valve is increased, regulated pressure routed to the actuator diaphragm (13) causes the butterfly (15) to open. When the resultant venturi delta-P reaches the predetermined value, as set by the calibration spring (12), the delta-P servo diaphragm moves. This causes the flexure beam (11) to lift off the servo valve and seat (20). This decreases pressure downstream of the control orifice (3), which closes the butterfly to a position that maintains the desired venturi delta-P. This delta-P corresponds to the desired high-flow setting when solenoid A (26) is deenergized.

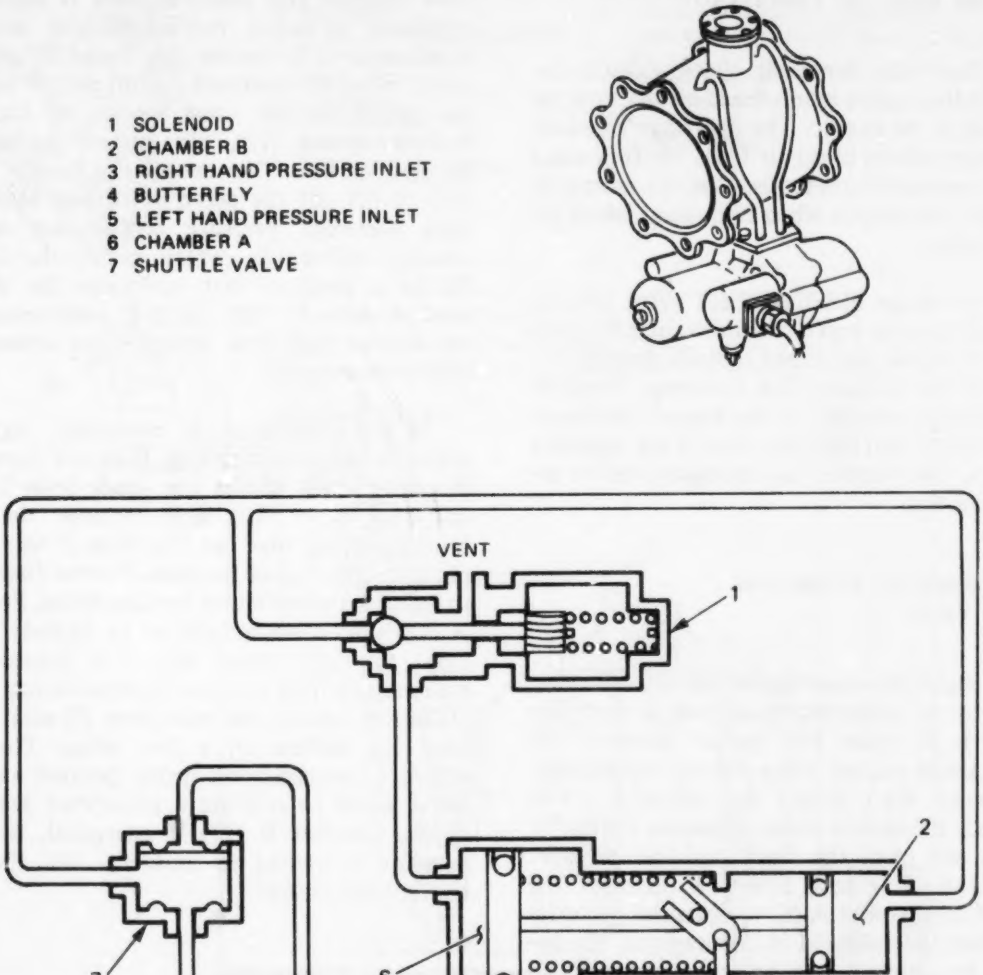
When solenoid A is energized, regulated pressure acting on the high-flow low-flow reset diaphragm (7) moves the reset lever to the low-flow stop (10) and reduces the calibration spring load on the delta-P servo diaphragm. This causes the delta-P servo diaphragm to regulate the airflow at low condition. Solenoid A is operated electrically by an altitude switch (25). As the venturi inlet (17) pressure increases, the inlet pressure compensating piston (5) moves against the reset lever (9) and modulates the airflow to a low value. The inlet pressure compensating spring preload and rate are selected to provide a prescribed schedule. When solenoid B (27) is energized, actuator pressure is vented to ambient, and the butterfly valve closes.

Bleed-Air Transmitter

The pressure transmitter senses the bleed-air pressure in the duct upstream from the bleed-air flow control and shutoff valve. The pressure transmitter transmits the pressure indication to the bleed-air pressure indicator on the environmental panel.

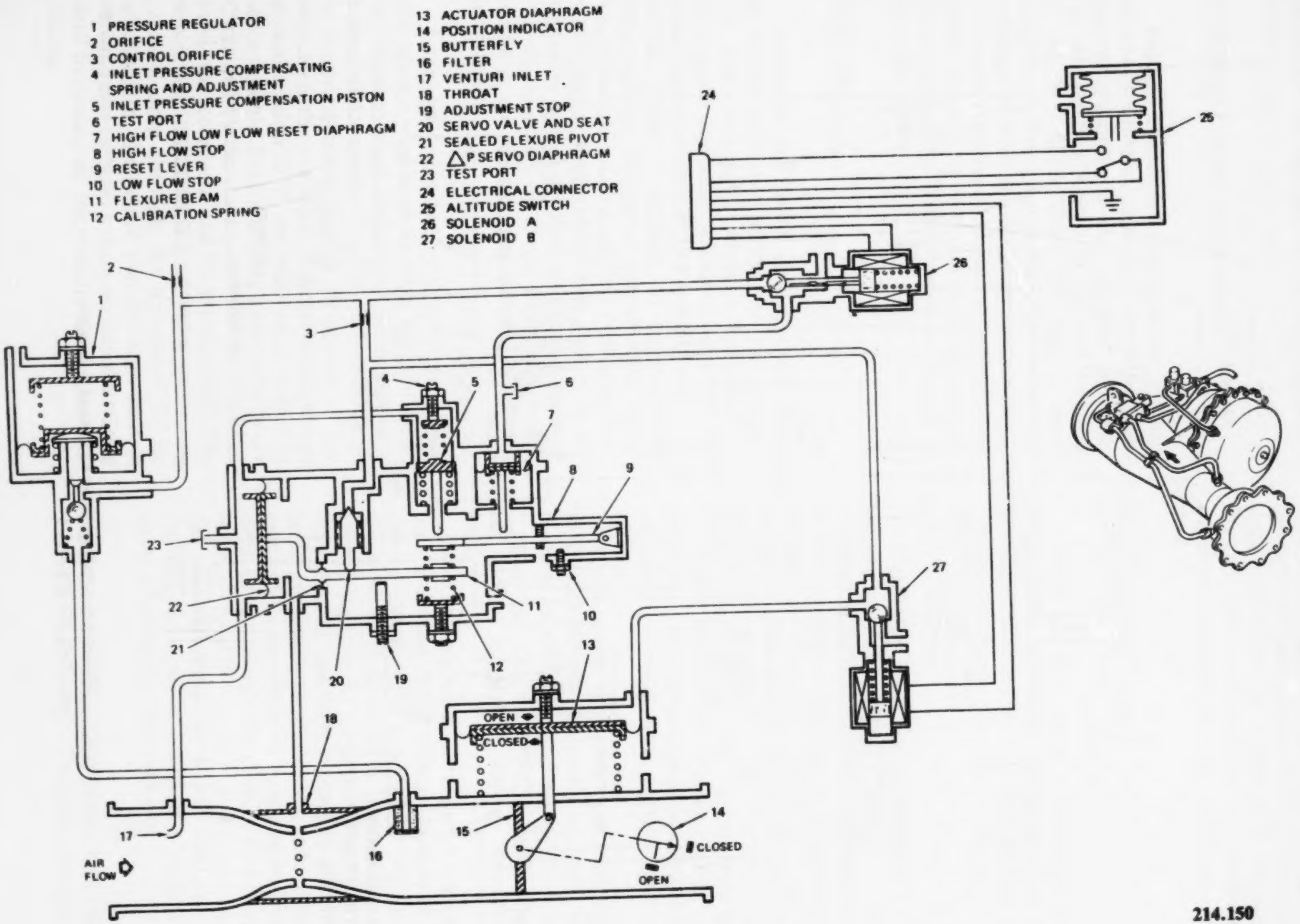
AIR-CONDITIONING SYSTEM

The air-conditioning system consists of two subsystems: refrigeration and cabin temperature control. These subsystems and their


1 SOLENOID
2 CHAMBER B
3 RIGHT HAND PRESSURE INLET
4 BUTTERFLY
5 LEFT HAND PRESSURE INLET
6 CHAMBER A
7 SHUTTLE VALVE
VENT
1
2
7
6
5
3
4

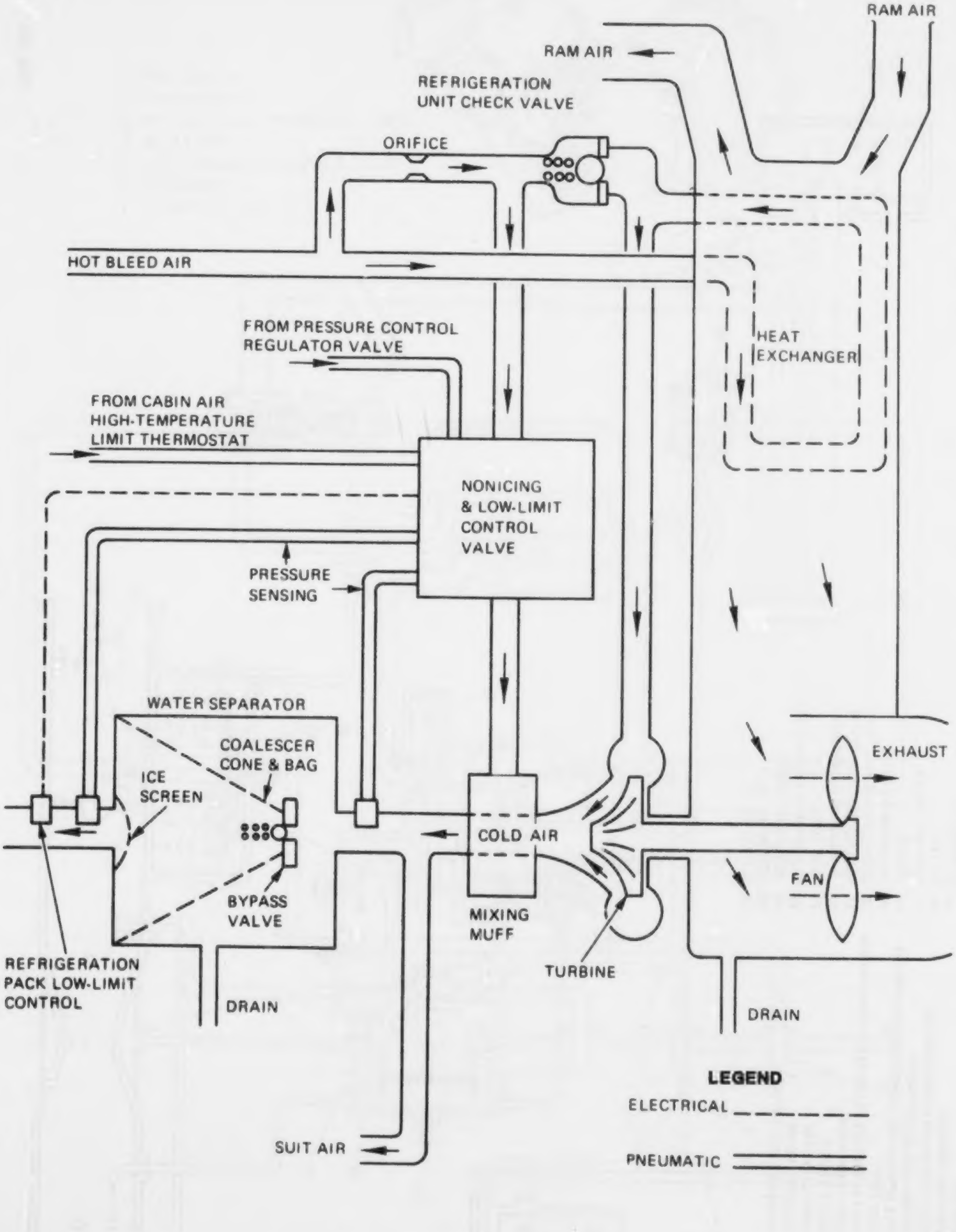
214.149

Figure 4-4.—Engine bleed-air bypass and shutoff valve.


1 PRESSURE REGULATOR
2 ORIFICE
3 CONTROL ORIFICE
4 INLET PRESSURE COMPENSATING SPRING AND ADJUSTMENT
5 INLET PRESSURE COMPENSATION PISTON
6 TEST PORT
7 HIGH FLOW LOW FLOW RESET DIAPHRAGM
8 HIGH FLOW STOP
9 RESET LEVER
10 LOW FLOW STOP
11 FLEXURE BEAM
12 CALIBRATION SPRING
13 ACTUATOR DIAPHRAGM
14 POSITION INDICATOR
15 BUTTERFLY
16 FILTER
17 VENTURI INLET
18 THROAT
19 ADJUSTMENT STOP
20 SERVO VALVE AND SEAT
21 SEALED FLEXURE PIVOT
22 △P SERVO DIAPHRAGM
23 TEST PORT
24 ELECTRICAL CONNECTOR
25 ALTITUDE SWITCH
26 SOLENOID A
27 SOLENOID B
OPEN
CLOSED
CLOSED
OPEN
AIR FLOW

214.150

Figure 4-5.—Bleed-air flow control and shutoff valve schematic.


RAM AIR
RAM AIR
REFRIGERATION UNIT CHECK VALVE
ORIFICE
HOT BLEED AIR
HEAT EXCHANGER
FROM PRESSURE CONTROL REGULATOR VALVE
FROM CABIN AIR HIGH-TEMPERATURE LIMIT THERMOSTAT
NONICING & LOW-LIMIT CONTROL VALVE
PRESSURE SENSING
WATER SEPARATOR
COALESCER CONE & BAG
ICE SCREEN
EXHAUST
COLD AIR
FAN
BYPASS VALVE
MIXING MUFF
REFRIGERATION PACK LOW-LIMIT CONTROL
TURBINE
DRAIN
DRAIN
LEGEND
ELECTRICAL
PNEUMATIC
SUIT AIR

214.151

Figure 4-6.—Refrigeration subsystem schematic.

components are discussed in the following paragraphs.

REFRIGERATION SUBSYSTEM

The refrigeration subsystem, shown in figure 4-6, consists of two physically separated packages: refrigeration and cabin air/water separator. The refrigeration subsystem operates on bleed air, which is temperature and pressure regulated. Passage through the ram air-cooled heat exchanger reduces the bleed-air temperature to within a few degrees of ambient air temperature. Further temperature reduction results from expansion at the turbine. Condensation is removed in the water separator.

System Operation

Regulated hot bleed air from the bleed-air supply subsystem enters the refrigeration unit heat exchanger, where it is cooled to within a few degrees of ram-air temperature. The cooled high-pressure bleed air enters a radial flow turbine, where it expands to approximately cabin pressure. The power output of the expansion turbine drives an axial-flow cooling air fan. A substantial temperature drop occurs in the expansion of high-pressure air to cabin pressure (165 psi bleed-air to 15 psi cabin air), which results in air temperatures well below ram-air temperature.

Depending upon the cool air temperature and dew point, a portion of the water vapor in the air condenses as small droplets. A water separator is installed downstream from the turbine discharge to remove between 50 and 70 percent of the moisture in the cooled air. If the turbine discharge air is also below 32 °F, the water vapor condenses as ice crystals. Potential icing and blockage are eliminated by the nonice and low-limit control valve, the ice screen, and the mixing muff. The nonice and low-limit control valve senses any pressure drop through the ice screen. If ice accumulates, the nonice and low-limit control valve admits turbines bypass air into the mixing muff to increase air temperature above icing conditions.

Ram cooling air for the heat exchanger flows through the heat exchanger core. The turbine shaft drives the fan, which pulls the ram air through the heat exchanger and discharges it overboard through the heat exchanger exhaust duct.

Component Description

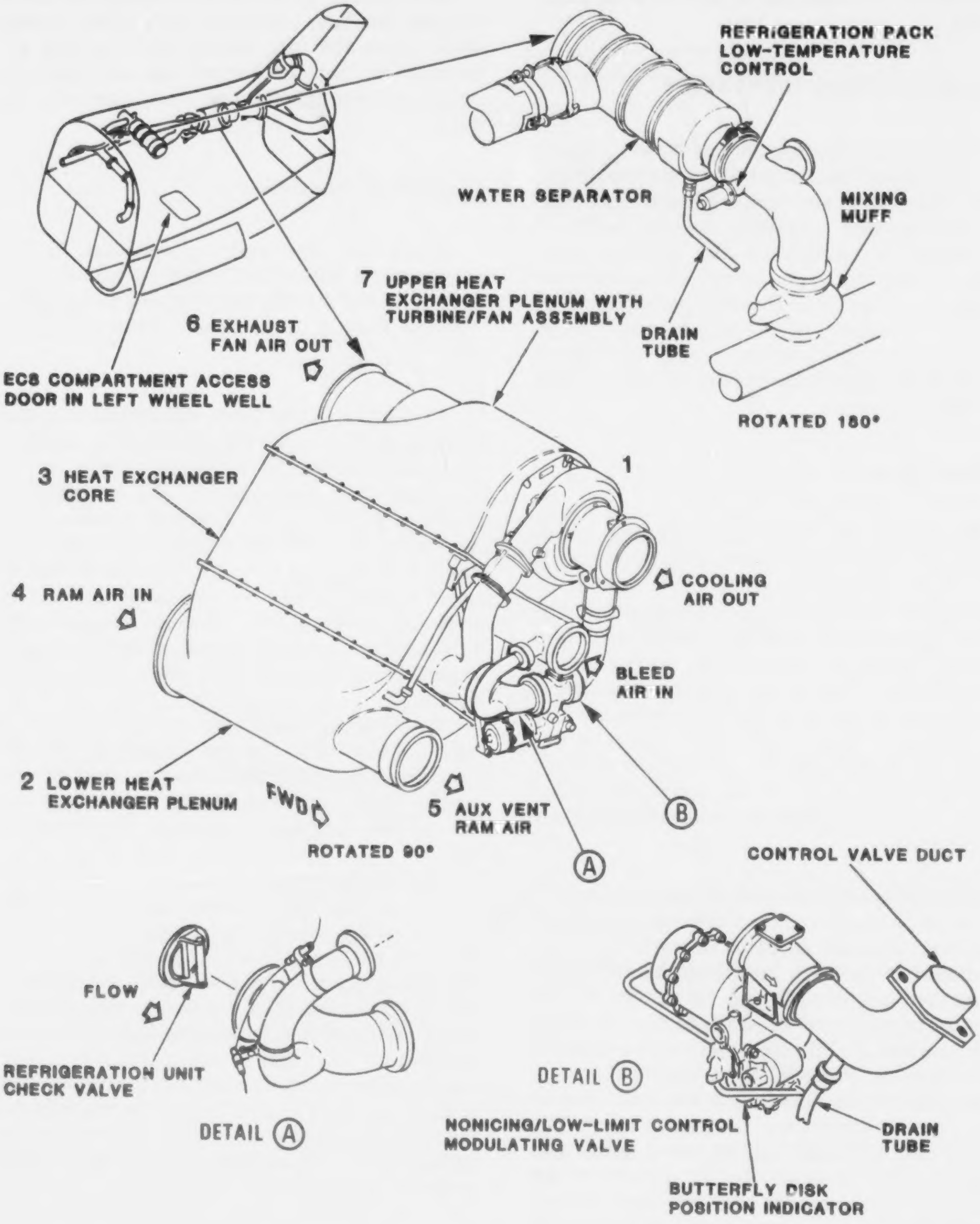
There are nine basic components in the refrigeration subsystem. Each of these components is discussed in the following paragraphs. The relationship of the items is shown in figure 4-6.

TURBINE AND FAN ASSEMBLY.—The turbine and fan assembly (figure 4-7), which is mounted in the heat exchanger upper plenum (7), is a removable component of the refrigeration package. High-pressure, partially cooled bleed air drives the turbine, which is mechanically coupled to an axial flow fan. The fan is used to impel ram air through the heat exchanger and an overboard exhaust duct. Pressure reduction and final heat loss occur as a result of energy loss and expansion of bleed air as it passes through the turbine.

Wool wicks, with one end submerged in MIL-L-23699 oil, transmit lubricant to the bearings supporting the common shaft of the turbine and fan assembly. A sight gage on the turbine housing is used to check the oil level.

Two overtemperature indicators are installed on the turbine. Each sensor probe head holds down a spring-loaded pop-up stem with an eutectic solder alloy. If the air in the passage reaches the melting point for the solder alloy, the indicator head pops up and stays exposed to alert maintenance personnel that the cooling turbine has been exposed to an excessive temperature level and needs to be replaced. The probe in the turbine inlet is set to trip at 217° ± 10 °F, and the probe in the fan inlet will trip at 450° ± 10 °F. Obstructions or collapse of the ram air inlet duct is the most likely cause of actuating this indicator.

HEAT EXCHANGER CORE, UPPER AND LOWER PLENUMS.—The heat exchanger lower


REFRIGERATION PACK
LOW-TEMPERATURE
CONTROL
WATER SEPARATOR
MIXING
MUFF
7 UPPER HEAT
EXCHANGER PLENUM WITH
TURBINE/FAN ASSEMBLY
DRAIN
TUBE
6 EXHAUST
FAN AIR OUT
ECS COMPARTMENT ACCESS
DOOR IN LEFT WHEEL WELL
ROTATED 180°
1
3 HEAT EXCHANGER
CORE
COOLING
AIR OUT
4 RAM AIR IN
BLEED
AIR IN
2 LOWER HEAT
EXCHANGER PLENUM
FWD
5 AUX VENT
RAM AIR
B
ROTATED 90°
A
CONTROL VALVE DUCT
FLOW
REFRIGERATION UNIT
CHECK VALVE
DETAIL A
DETAIL B
NONICING/LOW-LIMIT CONTROL
MODULATING VALVE
DRAIN
TUBE
BUTTERFLY DISK
POSITION INDICATOR

214.152

Figure 4-7.—Refrigeration package and water separator.

plenum (2) contains the ducting for the ram air inlet and outlet. Cooling ram air (4) flows into the lower plenum and through the heat exchanger core (3) and out through the overboard exhaust duct (6) to the upper plenum, or to the ram air augmentation subsystem (5).

The heat exchanger upper plenum (7), which supports the turbine and fan assembly (1), is mounted on the opposite side of the heater core (3). Ram air drawn through the heater core for cooling purposes is diverted to the heat exchanger exhaust duct (6) through the heat exchanger upper plenum. The heat exchanger core (3) is the air-to-air heat sink, and it uses ram air to cool the bleed-air supply.

NONICING AND LOW-LIMIT CONTROL MODULATING VALVE.—The nonice and low-limit control valve maintains conditioned airflow through the water separator by adding bleed air at the mixing muff to prevent water separator icing. (See figure 4-8.) Ice forming on the wire screen at the water separator discharge duct is detected by two pneumatic pickups located just before and after the water separator. These pickups sense a differential pressure across the water separator. If differential pressure is sensed across the water separator, the nonice and low-limit control valve will remain open until the temperature of the inlet air to the water separator is high enough to melt collected ice. When the ice is melted, the pressure differential returns to normal. In addition, the refrigeration pack low-limit control electrically signals the nonice and low-limit control valve when separator outflow drops to 0°F.

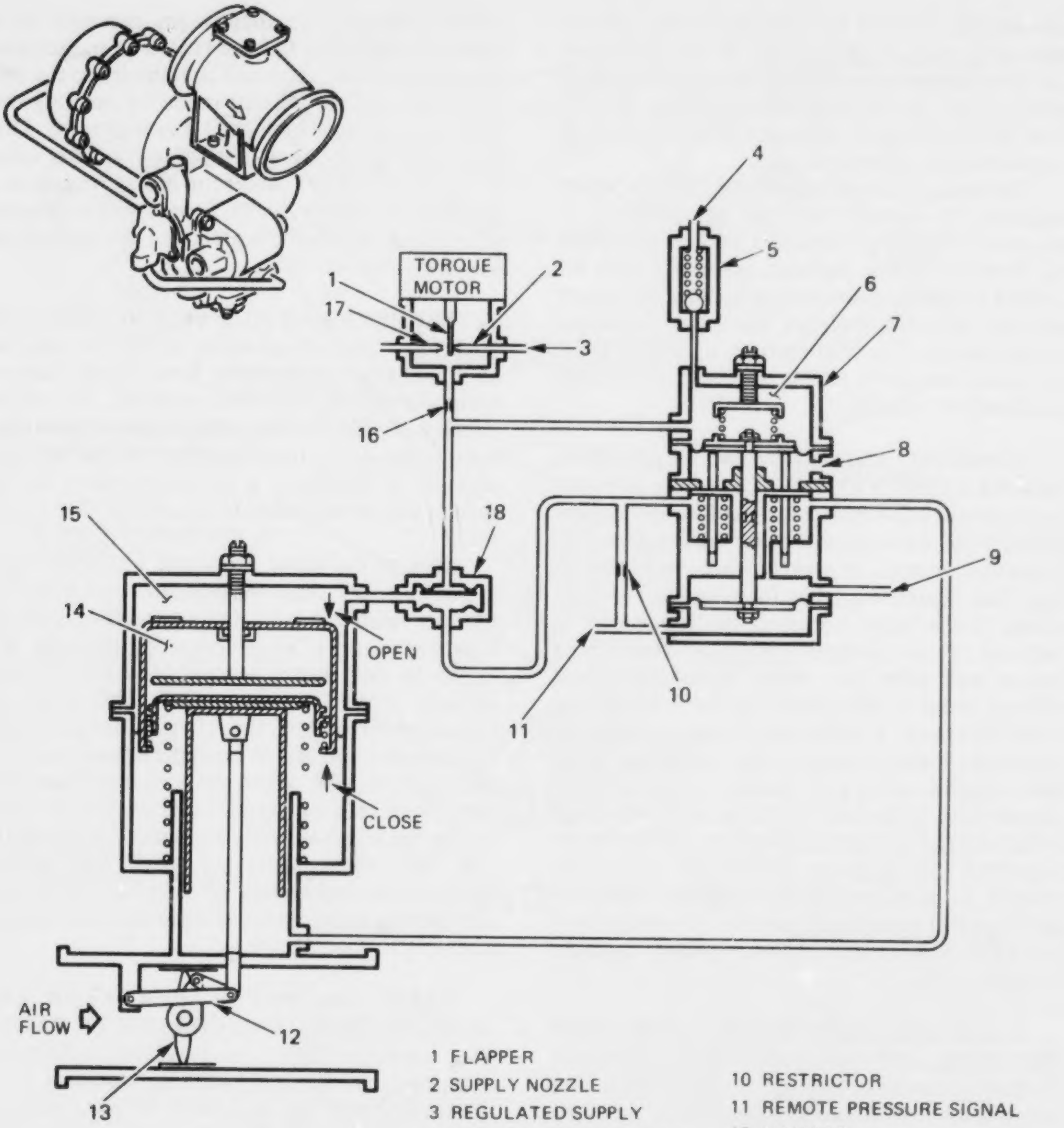
REFRIGERATION PACK LOW-LIMIT CONTROL.—The refrigeration pack low-limit control is located in the ECS compartment. (See figure 4-6.) It is mounted downstream from the water separator in a 6-inch duct of cooled bleed discharged air.

The refrigeration pack low-limit control uses 28-V dc power to energize its circuitry. A thermistor senses duct air temperature and compares it with an internally generated reference. The difference is amplified to modulate a torque motor in the nonice and low-limit control valve. (See figure 4-8.) The torque valve controls the regulated air supply (3) with a flapper valve (1) which controls the diaphragm pressure in a butterfly actuating linkage (12). The nonice and low-limit control valve can be returned to the differential pressure control mode by opening the cabin temperature high-limit thermostat (4). This causes the upper chamber (6) of the switcher valve (7) to be vented (17) and returned to its primary position. A check valve (5) is provided to prevent extraneous signals from affecting the nonice and low-limit control valve.

REFRIGERATION UNIT CHECK VALVE.—The refrigeration unit check valve is an insert-type check valve with a split flapper spring-loaded in the closed position. The valve, which is installed in the refrigeration unit to prevent hot bleed air from entering directly into the turbine, is located in a tee arrangement in the system just downstream of an orifice. (See figure 4-7.)

Icing of the water separator will occur only at low altitudes where mass airflow and temperature are relatively high. Only a small amount of high-temperature air is required through the orifice to melt such a deposit. However, at high altitude where the mass flow and bleed-air temperatures are low, the refrigeration pack low-limit control operates to open the nonice and low-limit control valve. When the nonice and low-limit control valve is open, high differential pressure across the bleed-air orifice permits the refrigeration unit check valve to open. This allows intermediate-temperature air to bypass the turbine and thereby maintain water separator temperature above 0°F. (See figure 4-6.)

CABIN AIR/WATER SEPARATOR, COALESCER CONE, AND COALESCER BAG.—The water separator is a welded cylindrical aluminum container installed downstream from the turbine and fan assembly. Its purpose is to remove a portion of the moisture condensed during the air-expansion process within the expansion turbine. (See figure 4-6.) The water separator container holds a coalescer bag, which collects the finely dispersed fog-like moisture discharged from the turbine. The wet air flows through the coalescer cone and through louvered swirl vanes to cause the heavier water particles to be deposited by centrifugal force against the outer surface of the collector section. Accumulated water is


TORQUE MOTOR
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
OPEN
CLOSE
AIR FLOW

1 FLAPPER
2 SUPPLY NOZZLE
3 REGULATED SUPPLY
4 TO CABIN TEMPERATURE HIGH LIMIT THERMOSTAT
5 CHECK VALVE
6 CHAMBER "C"
7 SWITCHER VALVE
8 AMBIENT VENT
9 REMOTE SENSING SIGNAL
10 RESTRICTOR
11 REMOTE PRESSURE SIGNAL
12 LINKAGE
13 BUTTERFLY
14 DAMPING FLUID, CHAMBER "B"
15 CHAMBER "A"
16 RESTRICTOR
17 VENT NOZZLE
18 SHUTTLE VALVE

214.153

Figure 4-8.—Nonicing and low-limit control modulating valve schematic.

drained through the sump in the bottom of the collector section. The partially dried air then leaves the water separator by way of the air outlet duct. The coalescer bag may be removed for cleaning through an access cover secured with a quick-disconnect band coupling to the water separator shell.

WATER SEPARATOR ICE SCREEN.—An ice screen is located in the discharge end of the water separator to collect ice when moisturized airflow temperature is below the dew point temperature or below 32 °F. The condensed ice crystals gathered across the ice screen cause a pressure differential, which is sensed by the nonice and low-limit control valve. The nonice and low-limit control valve then increases the warm air supply through the mixing muff, the coalescer bag, and to the ice screen to melt collected ice.

WATER SEPARATOR BYPASS VALVE.—The bypass valve is a spring-loaded valve mounted in the water separator container. A failure of the nonice and low-limit control valve could cause ice particles to build up in the water separator coalescer bag. This ice would block the cabin air system. To ensure that air is supplied to the cabin, the water separator bypass valve allows turbine air to bypass the coalescer bag.

CABIN TEMPERATURE CONTROL SUBSYSTEM

A cabin air temperature control sensor is located mid-cabin adjacent to the TACCO cooling air inlet. Its purpose is to ensure adequate airflow over the sensor, which measures cabin temperature and sends a signal, along with a signal from the cabin air temperature selector, to the cabin air temperature control. The cabin air temperature control then directs the cabin temperature control modulating valve to maintain a selected temperature in the cabin. During normal cruise, cabin air temperature is controlled by mixing water separator cold air with hot bleed-air. The control also acts as an anticipator to stabilize response from the supply duct sensor to the cabin temperature demand.

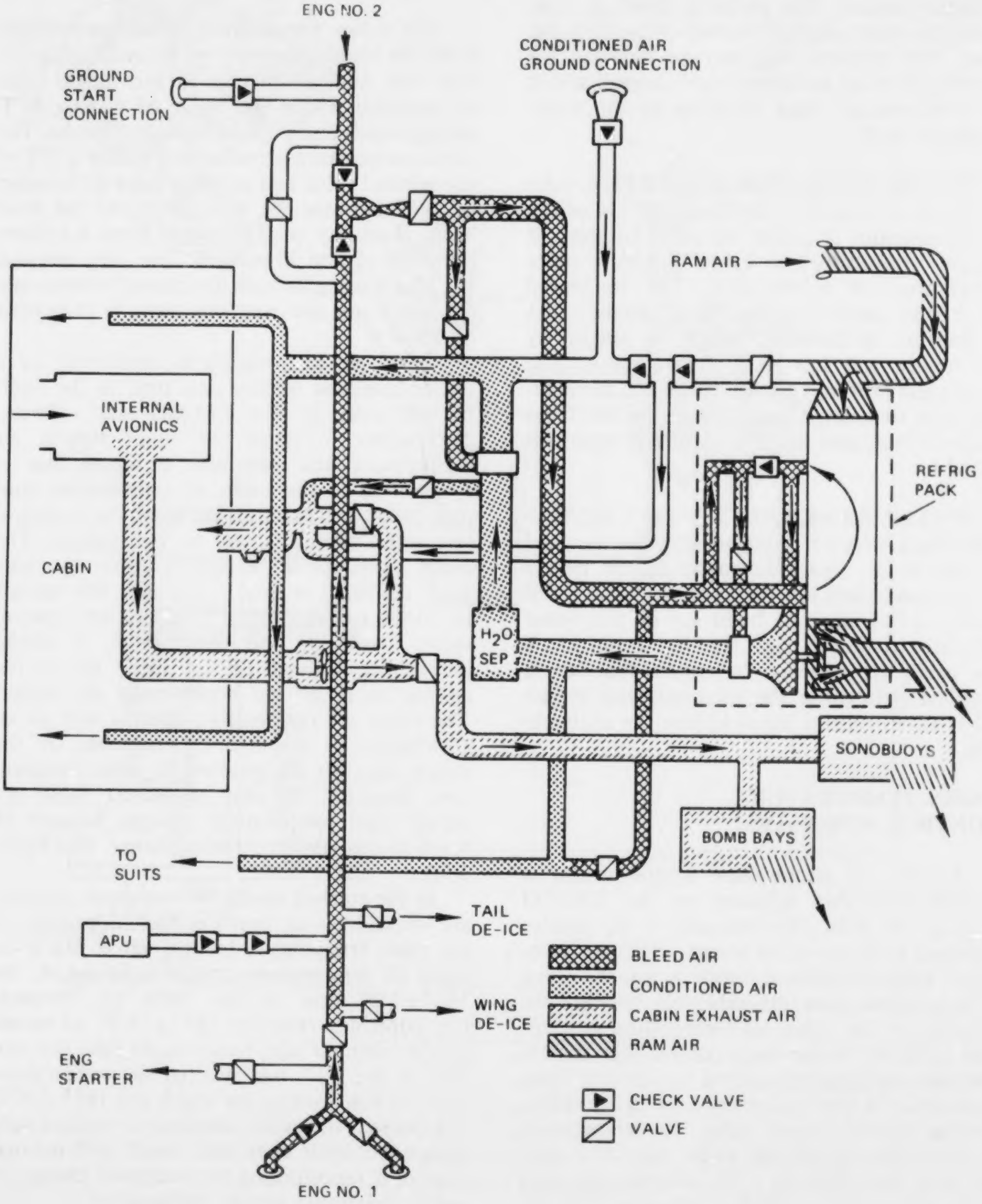
System Operation

The cabin temperature control subsystem cools the bleed-air supply by air-cycle refrigeration and ram air mixing to provide a cabin temperature within the range of 60° to 80 °F during steady and mild transient conditions. The cabin temperature is maintained within ± 3 °F of the selected value and a temperature differential of 10 °F between the floor level and the head level. Humidity control ranges from a relative humidity of 5 to 70 percent. The cabin exhaust air, after passing through the internal avionics and the sonobuoy and weapons bays, is exhausted overboard.

Cabin air temperature is monitored by a sensor mounted on the aisle next to the cooling air inlet at the TACCO side console. The sensor measures the flight station air temperature and generates a signal that is transmitted to the cabin air temperature control. Additionally, a signal from the temperature select switch is sent to the control. The cabin air temperature control senses the inlet duct temperature and compares the signals to modulate the cabin temperature control valve. Based on this comparison, it allows the proper amount of hot bleed air to the mixing muff at the conditioned air outlet. The cabin air temperature control acts as an anticipator to stabilize the response of the supply duct air temperature to cabin temperature demands. It also minimizes cabin air supply duct temperature changes because of bleed- or ram-air temperature change. (See figure 4-9.)

In the manual mode, the automatic controls are overridden to provide manual control of the cabin temperature control valve. Since the cabin air temperature control is bypassed, the 160° ± 5 °F limit on the cabin air temperature control is raised to 185° ± 15 °F, as sensed by the cabin air high-temperature limit thermostat. If the pilot has selected the temperature select switch position for which this 185° ± 15 °F is exceeded, the cabin temperature control subsystem will cycle open and closed until manual control is repositioned or conditions change to reduce maximum supply temperature.

The augmented air system provides ram air, as required, to supplement the conditioned bleed


ENG NO. 2
GROUND
START
CONNECTION
CONDITIONED AIR
GROUND CONNECTION
RAM AIR
INTERNAL
AVIONICS
REFRIG
PACK
CABIN
H_2O
SEP
SONOBUOYS
BOMB BAYS
TO
SUITS
TAIL
DE-ICE
APU
WING
DE-ICE
ENG
STARTER
ENG NO. 1
BLEED AIR
CONDITIONED AIR
CABIN EXHAUST AIR
RAM AIR
CHECK VALVE
VALVE

214.154

Figure 4-9.—ECS operation during pressurized flight.

air and to provide auxiliary ventilation. This ram air is drawn from the ram air scoop located in the base of the vertical stabilizer. The ram air is injected into the cabin air distribution ducting downstream from the mixing muff at the junction between the water separator discharge air and the cabin temperature control valve.

During unpressurized flight up to 3,500 feet (+1000 or −500 feet) with a ram air temperature between 20° ± 6 °F and 72° ± 6 °F, ram air supplements the conditioned bleed-air flow to the cabin. When operating in the automatic mode, the ram-air shutoff valve controls the duct-to-cabin pressure differential to 7.5 ± 2 inches of water to prevent flooding the cabin with ram air when the aircraft is flying at high speeds.

The ram-air shutoff valve is also used to provide auxiliary ventilation by securing the refrigeration package and relying on the pilot-operated auxiliary vent switch to adjust the ram-air shutoff valve. (See figure 4-10.) With the air-conditioning switch set to OFF, setting the auxiliary vent switch to ON closes the cabin recirculating air temperature control valve and opens the cabin pressure regulator valve. If the setting of the ram-air shutoff valve is such that ram pressure fails to satisfy cabin exhaust fan requirements, the negative pressure relief valve opens. This draws additional ambient air from the environmental control system compartment to compensate for any airflow deficiencies.

In the event of an automatic shutdown of the air-conditioning or pressurization system during single-engine waveoff, the cabin air supply temperature may change because the ram-air shutoff valve opens. Operation is restored by setting the air-conditioning switch to OFF and RESET and then back to ON, or by setting the auxiliary vent switch to modulate the ram airflow.

Cabin Temperature Control Components

Seven components are used to control cabin temperature. These components are discussed in the following paragraphs.

CABIN TEMPERATURE CONTROL MODULATING VALVE.—The cabin temperature control modulating valve has a visual position indicator and is spring-loaded to the closed position. It is located between the hot bleed-air duct going to the refrigeration unit and the cooled air duct coming from the refrigeration unit. The cabin air temperature control provides electrical power to a torque motor in the valve, which converts electrical signals into pneumatic signals that modulate the butterfly to a specific opening.

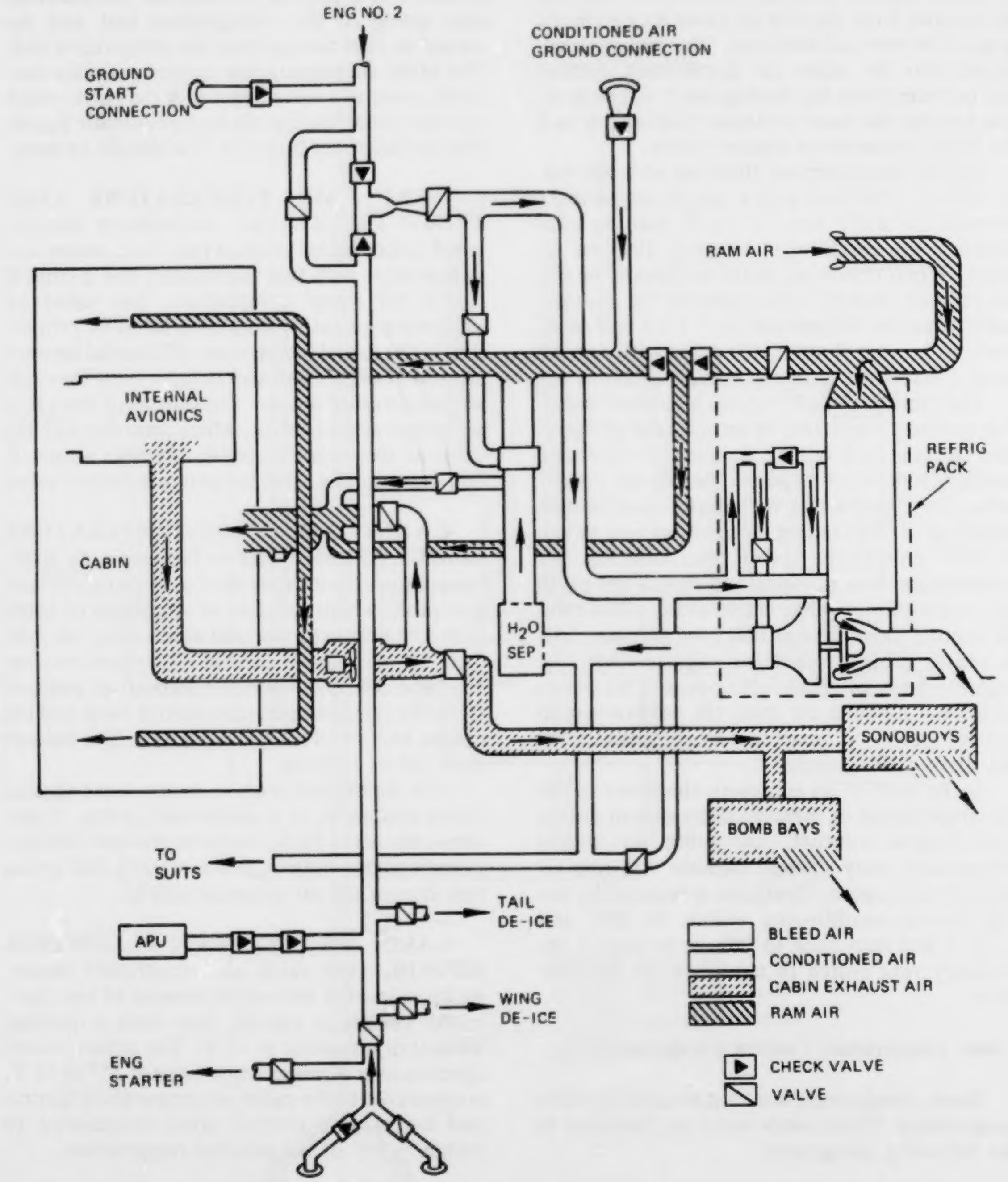
CABIN AIR TEMPERATURE CONTROL.—The cabin air temperature control, which is located in the cabin inlet duct, senses duct temperature with two thermistors and a control circuit for signal comparison. The cabin air temperature control output signal is in proportion to the sensed temperature differential between inlet duct temperature and an input from the cabin air temperature sensor. The output of the cabin air temperature control, which goes through the cabin air temperature selector, provides a controlling signal for the cabin temperature control valve.

CABIN AIR HIGH-TEMPERATURE LIMIT THERMOSTAT.—The cabin air high-temperature limit thermostat is a pneumatic control valve, which actuates as a function of cabin inlet air temperature sensed at the cabin air inlet duct. The thermostat internal valve opens between 182° and 200 °F and dumps regulated air pressure from the cabin temperature control valve and the nonice and low-limit control valve. This induces both valves to close.

The thermostat uses a temperature-sensing liquid contained in a sealed-wall probe. Vapor forms above the liquid, varies in pressure with surrounding temperature, and actuates a disk spring that dumps the air pressure supply.

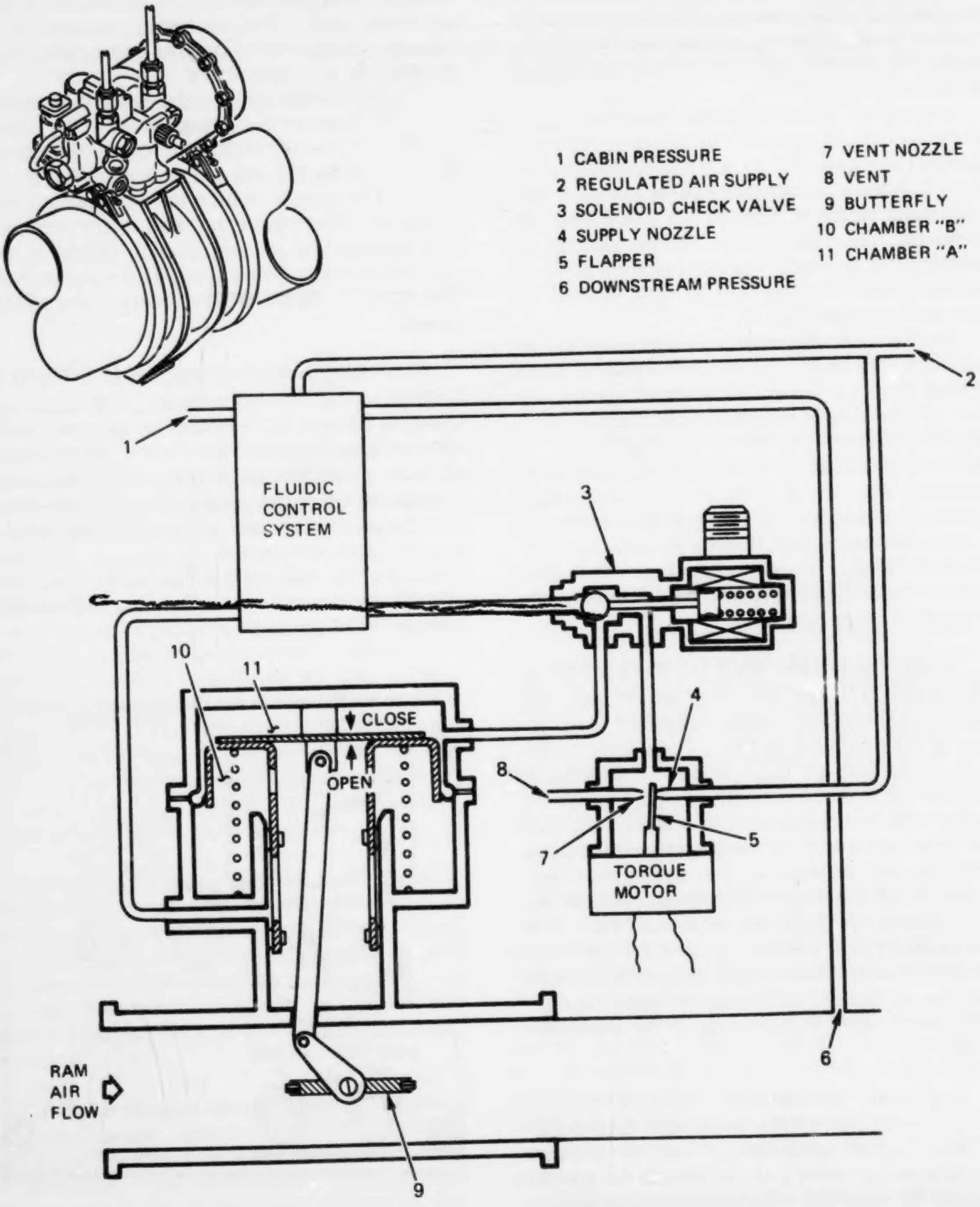
CABIN AIR TEMPERATURE CONTROL SENSOR.—The cabin air temperature sensor, which is located mid-cabin consists of two thermistor probes in parallel that have a nominal 4000-ohm resistance at 77 °F. The sensor, which operates over a temperature range of 55° to 85 °F, is connected to the cabin air temperature control and designed to control cabin temperature to within ± 3 °F of the selected temperature.

RAM-AIR SHUTOFF VALVE.—As shown in figure 4-11, the ram-air shutoff valve consists of a butterfly valve (9) and linkage. It is opened by a spring and closed by an air pressure actuated


ENG NO. 2
CONDITIONED AIR GROUND CONNECTION
GROUND START CONNECTION
RAM AIR
INTERNAL AVIONICS
REFRIG PACK
CABIN
H_2O SEP
SONOBUOYS
BOMB BAYS
TO SUITS
TAIL DE-ICE
APU
WING DE-ICE
ENG STARTER
ENG NO. 1
BLEED AIR
CONDITIONED AIR
CABIN EXHAUST AIR
RAM AIR
CHECK VALVE
VALVE

214.155

Figure 4-10.—ECS operation in aux vent mode.


1 CABIN PRESSURE
2 REGULATED AIR SUPPLY
3 SOLENOID CHECK VALVE
4 SUPPLY NOZZLE
5 FLAPPER
6 DOWNSTREAM PRESSURE
7 VENT NOZZLE
8 VENT
9 BUTTERFLY
10 CHAMBER "B"
11 CHAMBER "A"
FLUIDIC CONTROL SYSTEM
CLOSE
OPEN
TORQUE MOTOR
RAM AIR FLOW
1
2
3
4
5
6
7
8
9
10
11

214.156

Figure 4-11.—Ram-air shutoff valve schematic.

diaphragm (11). The diaphragm is activated by a regulated air supply that is controlled by a fluidic control system or a torque motor and flapper (5), depending upon whether the solenoid is energized or deenergized.

During the ram-air augmentation mode (automatic mode), the ram-air shutoff valve regulates downstream pressure to a fixed differential of 7.5 ± 2 inches of water above cabin pressure. The automatic mode is selected by energizing the solenoid. This allows the fluidic control to establish the differential across the valve actuator as determined by valve downstream pressure (6) and cabin pressure (1).

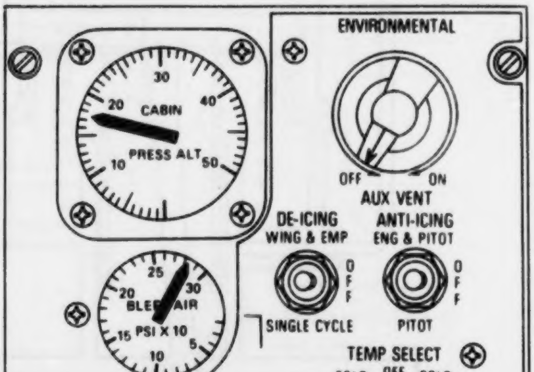
During manual operation (override mode), the auxiliary vent switch on the environmental panel is used to place the ram-air shutoff valve in any position from fully closed to fully open by varying electrical power to the valve torque motor. In the override mode, selected by deenergizing the solenoid, power is applied to the torque motor to close the pneumatic supply pressure nozzle and to open the vent nozzle, thereby lessening the ram-air shutoff valve actuator closing pressure. This permits the actuator spring to move the butterfly toward an open position.

RAM-AIR HIGH- AND LOW-TEMPERATURE LIMIT SWITCH.—The ram-air high- and low-temperature limit switch senses air temperature at the ram-air inlet duct. There are two circuits in the ram-air high- and low-temperature limit switch that are normally closed. One circuit opens with decreasing ram-air temperature, and the other opens with increasing ram-air temperature. The ram-air high- and low-temperature limit switch circuitry is interconnected with the bleed-air flow control valve, the ram-air shutoff valve, and the auxiliary vent switch. The ram-air high- and low-temperature limit switch operation controls the ram-air shutoff valve position when the ram-air shutoff valve is operating in the automatic mode.

GROUND AIR SUPPLY CHECK VALVE AND GROUND COOLING AIR CONNECTOR.—Support equipment provides low-pressure conditioned air when it is attached to the ground cooling air connector. The connector is located on the right side of the aircraft in the right wheel well at fuselage station (FS) 465. It is accessible through a hinged door on the underside of the sonobuoy deck. The connector consists of a silicone-impregnated nylon hose and a clamp supporting the air check valve.

The ground air check valve is a 4-inch diameter, split-flapper valve spring-loaded to the closed position. Ground cooling air opens the check valve and closes the ram and recirculated air check valves. The ground source low-pressure air bypasses the refrigeration unit and enters the cabin area because the air-conditioning system is not used when low-pressure ground air is connected. Therefore, the bleed-air flow control valve will be closed.

ENVIRONMENTAL CONTROL PANEL.—The environmental control panel, shown in figure 4-12, is located on the center console and is used by the flight crew to control temperature, pressurization, and anti-icing functions. The discussion of the panel is limited to the ram-air valve position selector, air-conditioning switch, and the cabin air temperature selector. The relationship of the cabin pressurization switch to the cabin pressure regulator safety valve is discussed later in the chapter.



214.157

Figure 4-12.—Environmental control panel.

Table 4-1.—Cabin Altitude versus Flight Altitude Schedule

Flight Altitude (ft)	Cabin Pressure Differential		Cabin Pressure Altitude	
	Min (psi)	Max (psi)	Min (ft)	Max (ft)
0	0	0.25	– 500	0
5,000	0	0.30	4,350	5,000
10,000	2.12	2.42	4,350	5,000
15,000	3.94	4.24	4,350	5,000
20,000	5.48	5.78	4,350	5,000
*24,300	6.60	6.80	4,500	5,000
25,000	6.60	6.80	5,000	5,380
30,000	6.60	6.80	7,400	7,870
35,000	6.60	6.80	9,600	10,100
40,000	6.60	6.80	11,520	12,050

*Maximum flight altitude for a 5,000 ft cabin altitude

Ram-Air Valve Position Selector.—When the ram-air valve position selector (AUX VENT SWITCH) is placed in the OFF position, the automatic mode is established by way of the fluidic control system. Clockwise rotation towards the ON position overrides logic controls of the air-conditioning system. Control of the ram-air shutoff valve is determined by the magnitude of the current, which is proportional to the setting of the auxiliary vent switch.

Air-Conditioning Switch.—The air-conditioning switch (AIR COND SWITCH) is used to activate the air-conditioning system. When air conditioning is automatically shutdown and the ram-air shutoff valve has fully opened, the air-conditioning switch must be set to OFF and RESET and then back to ON to restore normal operation.

Cabin Air Temperature Selector.—The cabin air temperature selector (TEMP SELECT SWITCH) has a manual and an automatic mode of operation. The temperature select switch operates manually in the same manner as the auxiliary vent switch. In the automatic mode, cabin temperature is selectable from 60° to 80°F.

PRESSURIZATION SYSTEM

The cabin pressurization subsystem regulates the outflow of air from the cabin to control the cabin pressure according to a predetermined schedule. Cabin air is drawn through the internal avionics racks by the cabin exhaust fan and is modulated by the cabin pressure regulator valve. A cabin pressure regulator control provides the pressurization schedule.

SYSTEM OPERATION

The cabin pressurization subsystem is governed by the pressure regulator control, which provides five modes of operation: unpressurized, isobaric, differential cabin-to-ambient pressure, dump, and repressurization.

Below 5,000 feet, the cabin is normally unpressurized. Between 5,000 and 25,000 feet, the cabin altitude will remain at 5,000 feet. Maximum cabin pressure-to-ambient differential is 6.7 ± 0.1 psi. Table 4-1 displays various cabin pressure differentials and cabin altitudes for different flight levels.

During the unpressurized mode of operation, the pressure regulator control directs low-pressure air to the pressure regulator valve to command it to the full open position. This mode of operation occurs at all altitudes below 4,350 feet. In this mode, cabin pressure is maintained at a near-ambient pressure. The pressure is slightly above ambient because of the duct pressure losses, the quantity of air flowing into the cabin, and the pressure across the internal avionics ventilation subsystem.

During flight operations between 5,000 and 24,000 feet, the isobaric mode maintains the cabin altitude between 4,350 and 5,000 feet. The pressure regulator control, using the sensed ambient pressure as a low-pressure source and the sensed cabin pressure as the high-pressure source, modulates the pressure regulator open or closed to maintain cabin pressure at the specific altitude.

The differential mode of operation overrides the isobaric mode of operation when the aircraft is flying at altitudes in excess of 24,000 feet. As cabin-to-ambient differential pressure reaches 6.7 ± 0.1 psi, a spring-loaded diaphragm in the pressure regulator control positions a poppet valve to supply this differential pressure as a control pressure to the pressure regulator valve. The pressure regulator valve compares this control pressure to cabin pressure, and it positions the butterfly valve to maintain the required differential pressure.

The cabin pressurization system also makes provision for dumping cabin pressure in an emergency. By setting the cabin pressure switch on the environmental control panel to the DUMP position, the latching solenoids on both the cabin outflow pressure regulating valve and on the cabin safety valve are actuated to the dump position. In addition, the recirculation air shutoff valve will be actuated to the full open position, provided electrical power is available. A secondary method of achieving cabin depressurization is to turn the air-conditioning switch to the OFF/RESET position and select the auxiliary vent mode. This selection will cause the cabin outflow pressure regulator valve to open, but it will not actuate the cabin safety valve to the open position.

The repressurization mode of operation is used when returning to the normal mode from the dump mode or during a rapid descent in excess of 4,000 feet per minute. In this mode, the pressure regulator control modulates the rate of cabin repressurization with an integral isobaric and differential pressure control system. The pressure regulator control compares the existing cabin pressure to a lagging cabin pressure reference. If the result of this comparison exceeds the calibrated rate, control pressure output from the pressure regulator control is reduced. This causes the pressure regulator valve to sense a relatively higher pressure on the opening side of its actuating diaphragm, thus allowing the diaphragm to open the pressure regulator valve butterfly. This reduces cabin pressure and the rate of repressurization.

Precautions for operating the cabin pressurization subsystem on the ground, where the elevation is 5,000 feet or higher, are required because the cabin pressurization subsystem does not have provisions for automatic depressurization. Therefore, the cabin will be pressurized whenever the ground elevation is above 5,000 feet.

To ensure adequate cooling of the internal avionics during operations at ground elevations above 5,000 feet, one of the following steps must be used:

1. Keep the cabin pressurized as in flight.
2. Set the cabin pressure switch to DUMP to ensure a full-open pressure regulator valve and a full open pressure safety valve.
3. If the outside air temperature is below 80 °F, turn the auxiliary vent selector to ON and open the cabin entry door.

COMPONENT DESCRIPTION

The pressurization system consists of five primary components. Four of them are shown in figure 4-13. The fifth component is located in the cockpit. Each component is discussed in the following paragraphs. If you are to troubleshoot effectively, it is important to know the relationship of each component to the system as a whole.

Cabin Pressure Regulator Valve

The cabin pressure regulator valve is a pneumatically actuated butterfly valve mounted in the cabin exhaust ducting downstream of the cabin exhaust fan. The butterfly is spring-loaded to the closed position and diaphragm operated to the open position. The pressure regulator valve consists of the butterfly valve, which is actuated by a pressure-controlled diaphragm and a solenoid valve to control the air pressure on the diaphragm.

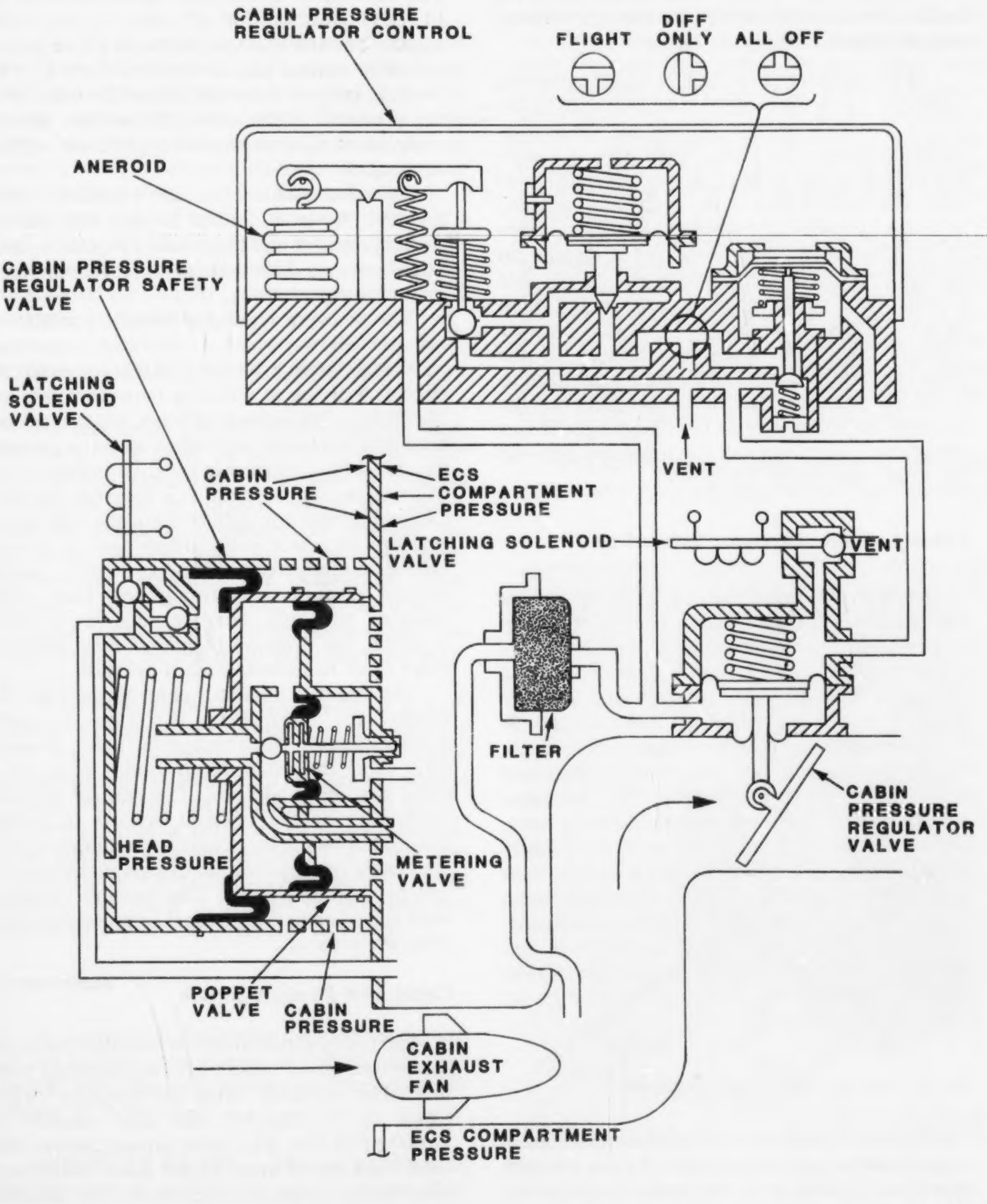

CABIN PRESSURE REGULATOR CONTROL
FLIGHT
DIFF ONLY
ALL OFF
ANEROID
CABIN PRESSURE REGULATOR SAFETY VALVE
LATCHING SOLENOID VALVE
CABIN PRESSURE
ECS COMPARTMENT PRESSURE
LATCHING SOLENOID VALVE
VENT
VENT
FILTER
CABIN PRESSURE REGULATOR VALVE
HEAD PRESSURE
METERING VALVE
POPPET VALVE
CABIN PRESSURE
CABIN EXHAUST FAN
ECS COMPARTMENT PRESSURE
214.158

Figure 4-13.—Cabin pressurization subsystem schematic.

The solenoid valve is electrically connected to the cabin pressurization switch on the the environmental panel. (See figure 4-12.)

There are three ports leading into the pressure regulator valve diaphragm chamber. (See figure 4-13.) The first port is located on the spring-loaded closing side of the diaphragm. It admits pressure from the cabin pressure regulator control. The second port is the ambient vent port. It is also located on the spring-loaded closing side of the diaphragm. The third port is located on the opening side of the diaphragm. A sensing line is attached to the third port to connect the cabin pressure regulator control and the cabin pressure exhaust duct. The pressure admitted to the diaphragm through the third port is equivalent to cabin air pressure. The difference between the pressure on either side of the diaphragm causes the pressure regulator valve to modulate between the open and closed positions.

Cabin Pressure Regulator Safety Valve

The pressure safety valve is an independent, pneumatically operated, balanced type of poppet valve that limits cabin-to-ambient pressure differentials to 7.07 (+0.2 and −0.0) psi. If the difference between cabin pressure and ambient pressure reaches the calibrated limit, the change in pressure acting on the limit control diaphragm overcomes the metering valve spring-load and allows the metering valve to open. This also opens a passage in the cabin pressure safety valve head, which causes the head pressure to be slightly lowered. Since the cabin pressure is greater than head pressure, it opens the pressure-balanced main poppet to allow cabin air to be vented overboard. When the cabin pressure differential is restored to normal, the limit control metering valve closes and the pressure safety valve returns to its normally closed position.

Cabin Pressure Regulator Control

The pressure regulator control is a pneumatic control that provides four modes of cabin pressure operation. In addition to the modes of operation, a test valve is included with three manually set positions: FLIGHT, DIFF ON, and ALL OFF. The test valve is normally lock-wired in the FLIGHT position for all cabin pressurization modes. The DIFF ON position permits a ground test of the normal delta-P setpoint. The ALL OFF position permits a ground test of the setpoint of the pressure safety valve. These tests are accomplished with pressure supplied by support equipment.

Four pneumatic ports are provided on the pressure regulator control for use with various sensed pressures and the pressure regulator valve. These ports are different sizes to prevent improper plumbing connections.

The pressure regulator control contains an isobaric bellows, which is calibrated to maintain an aircraft cabin pressure of 5,000 feet while the aircraft is flying at altitudes between 5,000 and 24,000 feet. The isobaric bellows, which modulate a control pressure, use cabin air as a pressure source and low pressure in the environmental control system compartment as a negative pressure. Control pressure is delivered to one side of the pressure regulator valve diaphragm and cabin pressure is connected to the opposite side. Because control pressure is normally less than cabin pressure and will decrease relative to cabin pressure, the pressure regulator valve becomes more open to decrease cabin pressure.

The pressure regulator control contains provisions for controlling the rate of cabin repressurization when recovering cabin pressure after using the cabin dump mode, or during a rapid descent in altitude. The control pressure modulated by the isobaric bellows is further modulated by the repressurization diaphragm to limit cabin repressurization to an equivalent 4,000 feet per minute change. The pressure regulator valve is held open until normal pressure characteristics are sensed.

Cabin Low-Pressure Switch

The low-pressure switch is installed below the center console to sense the cabin absolute pressure. The normally open low-pressure switch closes at 13,000 ± 500 feet and reopens at 11,000 ± 500 feet. The cabin pressurization indicator light on the annunciator panel illuminates when the low-pressure switch closes. The indicator light goes off when the low-pressure switch reopens.

Cabin Air Pressure Sensing Filter

The air pressure sensing filter is located in the line that connects the cabin exhaust air duct, the cabin pressure regulator control, and the cabin pressure regulator valve. The replaceable filter element, which is connected to the air sensing tube, is mounted with clamping rings on the fuselage frame. The filter element is a cylindrical plug of treated paper and fabric in a metal housing. The clamping rings confine the air entry to the dome-shaped end to trap the entry of tobacco tar and dust particles greater than 10 microns in diameter.

CABIN LEAKAGE TEST EQUIPMENT

To test cabin pressurization systems satisfactorily, you must be able to operate cabin leakage test equipment. The tester is designed to supply air to aircraft cabin or canopy seals at controlled pressures for checking the cabin or canopy seals for safety and satisfactory performance. The pressurized cabin leakage tester, PN 89405, manufactured by Sprague Engineering Corporation, Gardena, California, is discussed in the following paragraphs.

The tester, shown in figure 4-14, is a completely self-contained, portable unit consisting of a cabinet assembly, cart assembly, canopy pressurization system, cockpit leakage testing system, complete instrumentation, and an accessory kit that is made up of hoses, adapter, hose clamps, and stethoscope. The tester uses air from a plant or portable compressed air supply source. The tester is capable of handling free air up to 200 cfm at pressures to 90 psi.

Description

In studying the following detailed description of the various components of the test unit, you should make frequent reference to the schematic shown in figure 4-15.

AIR INLET FILTER.—The air inlet filter (9) incorporates a replaceable micronic-type filter element that ensures a filtered air supply to the test system and aircraft.

CABIN PRESSURE ADJUSTMENT.—The cabin pressure adjustment (16), located on the instrument panel, is a pilot valve assembly that controls the pressure at which the main relief valve (18) will dump input air. It controls the pressure applied against a diaphragm in the main relief valve. A spring-loaded restrictor in the pilot valve completes the pressure regulation. The spring-load is controlled by varying the position of the knurled adjusting knob.

A dial marked in increments of one psi rotates with the adjusting knob to give an indication of the pressure setting at which the main relief valve will dump. A safety relief valve (17), set at 13 psi, is connected to the control pressure line between the pressure adjustment (16) and the main relief valve (18) to limit control pressure applied to the main relief valve to a 13 psi maximum.

RELIEF VALVE ASSEMBLY.—The main relief valve (18) consists of two air chambers

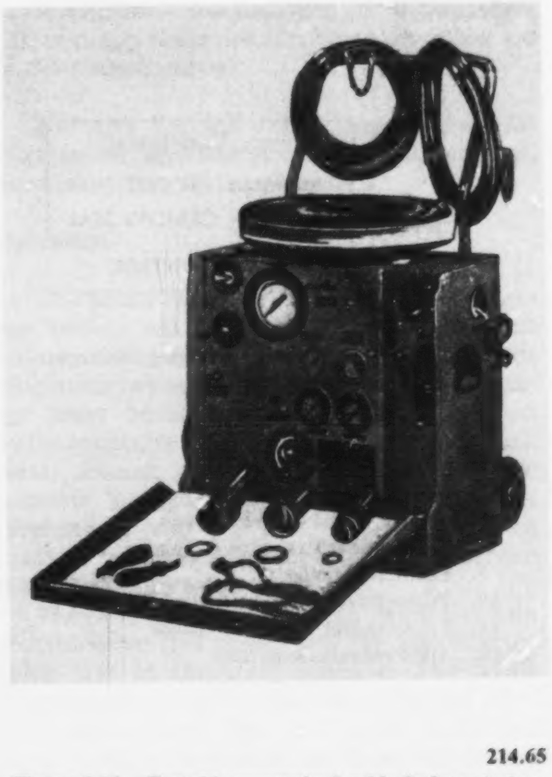


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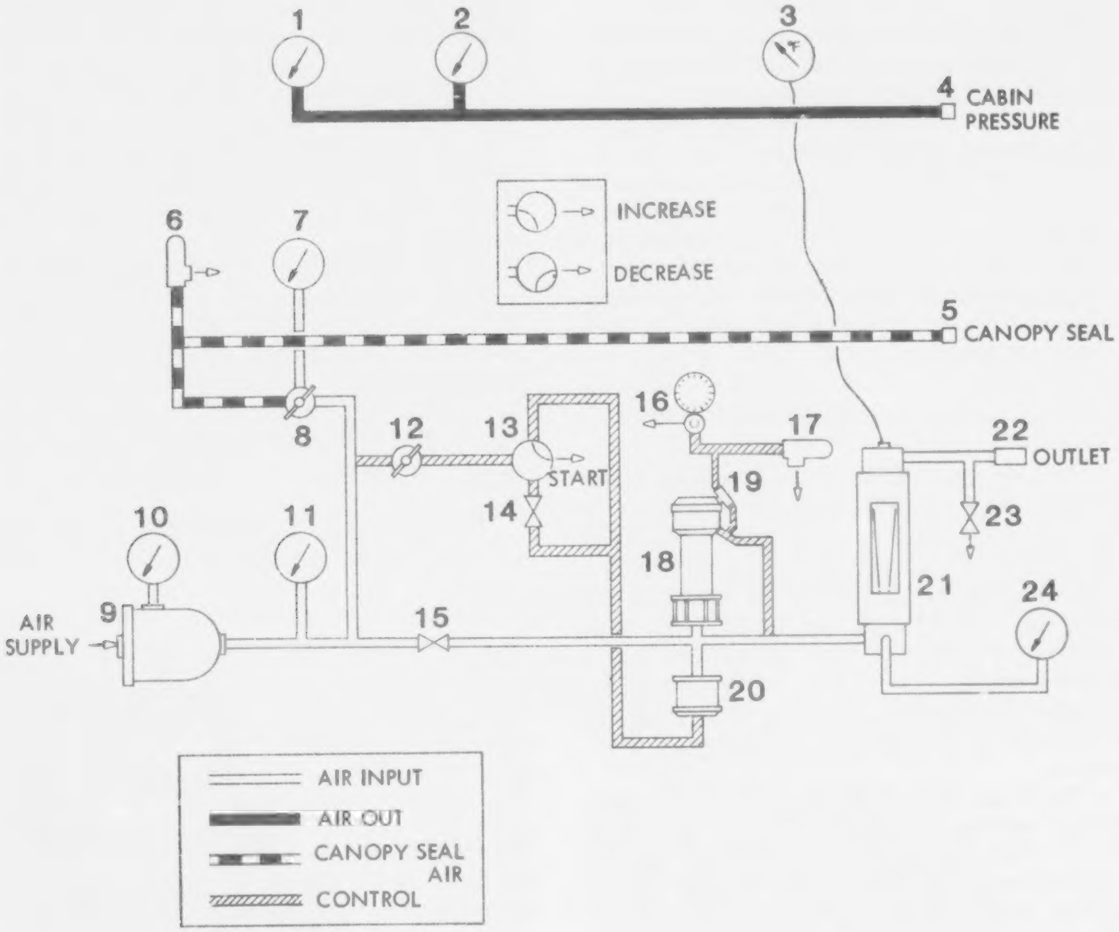
Figure 4-14.—Portable pressurized cabin leakage tester.


1
2
3
4 CABIN PRESSURE
INCREASE
DECREASE
6
7
5 CANOPY SEAL
16
8
12
13
17
22
OUTLET
START
19
14
23
10
11
18
21
24
AIR SUPPLY
9
15
20
AIR INPUT
AIR OUT
CANOPY SEAL AIR
CONTROL

1. Rate of Cabin Pressure Change Indicator
2. Cabin Pressure Gauge
3. Air Temperature Gauge
4. Bulkhead Union
5. Bulkhead Union
6. Relief Valve
7. Canopy Seal Pressure Gauge
8. Canopy Seal Pressure Regulator
9. Filter Assembly
10. Filter Inlet Pressure Gauge
11. Filter Outlet Pressure Gauge
12. Air Pressure Regulator
13. Rate Selector Valve
14. Rate Control Valve
15. Flow Control Valve
16. Pressure Adjustment
17. Relief Valve
18. Main Relief Valve
19. Restrictor
20. Rate Valve
21. Flowmeter
22. Air Outlet
23. Bypass Valve
24. Blower Pressure Gauge

214.159

Figure 4-15.—Cabin leakage tester schematic.

separated by a diaphragm. The center of the diaphragm is reinforced with metal plates. A long rod, attached to the metal plates and diaphragm, extends into a third chamber that contains a spring-loaded plunger and neoprene seat. The noeprene seat acts as the base of the relief valve assembly.

Pressurized air is retained in the system by the seal established when the neoprene seat contacts the lip of the metallic seat. Balanced air pressure in the two air chambers, as opposed to the spring-loaded plunger and seat and inlet air pressure, determines the pressure at which the valve will relieve. The top air chamber is connected to the lower air chamber and the cabin pressure adjustment control on the instrument panel. The lower air chamber is also connected into the main airstream downstream of the relief valve. If the setting of the cabin pressure adjustment is below the input air pressure, air escapes from the upper air chamber through the cabin pressure regulator faster than it enters the chamber. This causes an imbalance that actuates the diaphragm in the main relief valve, allowing input air pressure to unseat the relief valve that vents input air pressure to the atmosphere.

RATE VALVE.—The rate valve (20) automatically limits the rate of cabin pressure increase or decrease to a preset value selected by the operator. This valve operates with the rate control valve (14), rate selector valve (13), and air pressure regulator (12). The rate control valve meters air into and out of the upper chamber of the rate valve to control the actual rate of pressure increase or decrease in the aircraft cabin. The rate selector valve controls the operation of the rate valve, through the tester start, increase, and decrease operation. The control pressure regulator is set at the factory to maintain the control air pressure supplied to the rate valve at a constant 12 psi during increase operations.

FLOWMETER.—The flowmeter (21) indicates the rate of cabin air leakage. It consists of a tapered Pyrex glass tube which contains a steel float. The float is free to rise and fall between upper and lower stops incorporated in the flowmeter. Air flowing through the flowmeter assembly raises the float from the lower stop. The height to which the float ascends is directly proportional to the flow rate.

The tube is etched with a special scale to help you read the pressure-corrected flow at any pressure from 0 to 12.4 psi. Flowmeter reading instructions are attached to the instrument panel. Input air pressure is represented by vertical lines, which are numbered at the bottom of the scale from 0 to 12.5 psi.

Airflow in cubic feet per minute of standard air (14.7 psi at 70°F) is represented by diagonal or curved lines. The capacity of the flowmeter is 0 to 200 cubic feet per minute at 2 to 12.5 psi. For temperatures other than 70°F, corrections must be made to obtain the correct flow. A temperature correction curve is provided on the instrument panel.

FLOW CONTROL VALVE.—The flow control valve (15) is a manually operated globe valve that admits the air supply to the tester system.

WARNING: Do not open the bypass valve (23) to dump cabin pressure when personnel are in the aircraft cabin.

BYPASS VALVE.—The bypass valve (23) is a manually operated globe valve that dumps all air downstream of the flowmeter.

Operation

To operate the portable cabin pressure leakage tester, you must first position the test unit as close as possible to the external aircraft test fitting connections. Then, connect the leakage tester hoses to these fittings as directed by the applicable maintenance instruction manual. Next, connect an external air source to the portable leakage tester and make sure it is receiving at least 200 cfm. The tester is then ready to be operated as specified by the service manual for this unit.

The leakage test is started with the rate control valve (14) closed and the rate selector valve (13) in the start position. This vents the pressurized control chamber of the rate valve to the atmosphere. The valve moves to the full open position to bypass the input air to the atmosphere.

The rate control valve (14) opens in increments of one-sixteenth of a turn until desired rate of increase is obtained. This is indicated on the rate of cabin pressure change gage (1). As the rate control valve (14) is adjusted, the rate valve (20) closes slowly until the pressure setting of the main relief valve (18) is reached, at which time the relief valve operates to hold the pressure at a preset value. From this point, you should proceed with the cabin leakage test according to the instructions found in the applicable maintenance instructions manual.

Upon completion of the test, the rate selector valve (13) is operated to decrease, which bleeds the control air pressure from the control chamber of the rate valve. This allows the valve to open slowly and dump the cabin air pressure. The source of air is then secured and all hoses between the test unit and aircraft are disconnected.

TROUBLSHOOTING SKILLS

Much of the AME's time is spent troubleshooting equipment in the squadron's aircraft. Troubleshooting on the S-3 aircraft environmental control system involves the use of the multimeter to check the resistance of the temperature sensor and to check the voltage to electrical connectors. The material presented in the following paragraphs will increase your knowledge of the multimeter and increase your proficiency as a troubleshooter. If you are not sure of the proper and safe methods for using this equipment, you should request the assistance of an aviation electrician (AE).

MULTIMETER

A multimeter is the most common electrical measuring device used in the Navy. The name multimeter comes from the words MULTIple METER. The multimeter is a direct current (dc) ammeter, an alternating current (ac) ammeter, a dc voltmeter, an ac voltmeter, and an ohmmeter all in one package. Figure 4-16 is a sketch of a typical multimeter. While it may look complicated, it is very easy to use.

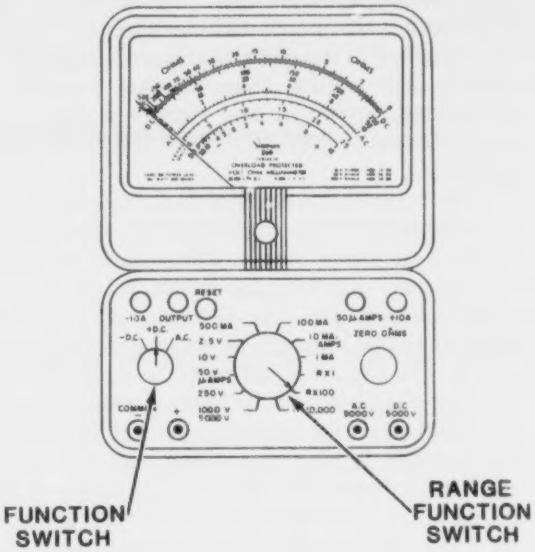


Figure 4-16.—A typical multimeter.

Jacks

The lower portion of the meter contains the function switches and jacks for the meter leads. The COMMON or (–) jack is used in most functions of the meter. One meter lead is plugged into the common jack. The (+) jack is used for the second meter lead for any of the functions printed in large letters beside the function switch (the large switch in the center). The other jacks have specific functions printed above or below them and are self-explanatory. The output jack is used with the DB scale and will not be explained. To use one of the special function jacks, except the +10 amps, one lead is plugged into the common jack, and the function switch is positioned to point to the special function printed in small letters.

For example, to measure a very small current (20 microamperes), one meter lead is plugged into the common jack, the other meter lead is plugged into the 50 μamps jack, and the function switch is placed in the 50V/μ amps position. To measure currents above 500 milliamperes, the +10A and –10A jacks are used for the meter leads, and the function switch is placed in the 10MA/AMPS position.

Function Switches

The function switch is used to select the function desired. The −dc, +dc, ac switch selects direct or alternating current and changes the polarity of the direct current functions. To measure resistance, this switch should be in the +dc position.

The zero ohms control is a potentiometer for adjusting the 0 reading on ohmmeter functions. The reset is a circuit breaker and is used to protect the meter movement. Not all multimeters have this protection, but most have some sort of protection, such as a fuse.

When the multimeter is not in use, it should have the leads disconnected and be switched to the highest voltage scale and ac. These switch positions are most likely to prevent damage if the next person using the meter plugs in the meter leads and connects them to a circuit without checking the function switch and the dc/ac selector.

Scales

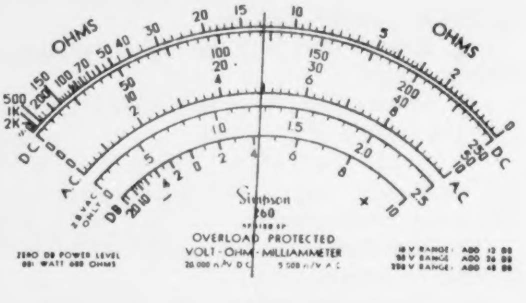
The numbers on the uppermost scale in figure 4-17 are used for resistance measurement. If the multimeter was set to the R × 1 function, the meter reading would be approximately 12.7 ohms.

The numbers below the uppermost scales are used for dc voltage and current. These numbers are also used with the scale just below them for ac voltage and current. The fourth scale from the top and the numbers just below the scale are used for the 2.5-volt ac function only. The lowest scale (labeled DB) is not discussed. Figure 4-17 shows how the given needle position should be interpreted with various functions selected.

MULTIMETER SAFETY PRECAUTIONS

As with other meters, the incorrect use of a multimeter could cause injury or damage. The following safety precautions are the minimum for using a multimeter:

1. Deenergize and discharge the circuit completely before connecting or disconnecting a multimeter.
2. Never apply power to the circuit while measuring resistance with a multimeter.



FUNCTION SWITCH	−D.C./+D.C. A.C.	INDICATION
5000 V	+ d.c.	+2420.00Vd.c.
1000 V	− d.c.	− 482.00Vd.c.
250 V	+d.c.	+ 121.00Vd.c.
50 V	a.c.	24.90Va.c.
10 V	a.c.	4.99Va.c.
2.5 V	a.c.	1.28 Va.c.
10 A	+d.c.	4.82 Ad.c.
500 mA	a.c.	249.00mAa.c.
100mA	a.c.	49.90mAa.c.
10mA	+d.c.	4.82mAd.c.
50μA	+d.c.	24.20μAd.c.
R x 100	+d.c.	1.27 kΩ

Figure 4-17.—A multimeter scale and readings.

3. Connect the multimeter in series with the circuit for current measurements, and in parallel for voltage measurements.
4. Be certain the multimeter is switched to ac before attempting to measure ac circuits.
5. Observe proper dc polarity when measuring dc.
6. When you are finished with a multimeter, switch it to the OFF position, if available. If there

is no off position, switch the multimeter to the highest ac voltage position.

7. Always start with the highest voltage or current range.

8. Select a final range that allows a reading near the middle of the scale.

9. Adjust the 0 ohms reading after changing resistance ranges and before making a resistance measurement.

10. Be certain to read ac measurements on the ac scale of a multimeter.

11. Observe the general safety precautions for electrical and electronic devices.

MULTIMETER TESTS

All valves are not constructed in the same manner. Therefore, the electrical tests performed on a valve should be accomplished as directed by the appropriate maintenance instructions manual (MIM). The voltage and resistance tests described in the following paragraphs are examples and should not be used as references for the performance of tests on aircraft.

Voltage Test

In order to perform a voltage test of the S-3 bleed-air shutoff valve, you must first secure power to the valve. Set the function switch of your multimeter to the +DC position. Set the range select switch to the 50V position. Next, insert the black test lead in the (–) common jack and the red lead in the (+) jack.

Before proceeding, you should review the appropriate maintenance instructions manual for the correct placement of the test lead probes with respect to the connector pins. You should also review the voltage requirements for a successful test. Finally, you should ensure that all circuit breakers and switches are in the correct position.

After applying power to the connector, be sure that you are using the correct meter scale to obtain the voltage reading. In this example, you would use the 50 DC scale. With the test completed, you should return to the MIM for the remainder of the steps in the troubleshooting procedure.

Resistance Test

In order to perform a resistance check on an S-3 cabin temperature sensor, you must secure power to it. Then, ground the sensor to remove any voltage that may remain in the circuit. Set the function switch to the +DC position. Set the range select switch to the R × 100 position. Next, insert the black test lead in the (–) common jack and the red lead in the (+) jack.

With the power removed and the meter preset, short the test leads by touching them together. Then place the meter in a horizontal position and rotate the 0 ohms control until the meter indicates zero. It is important to keep the meter in the same position for the entire test to ensure accurate readings.

NOTE: The function switch may have to be reset to keep the resistance reading near the midscale point.

Because ambient temperature affects the resistance of the sensor, you should refer to the air temperature versus resistance schedule chart of the MIM to obtain the prescribed resistance readings. The MIM should also be consulted for the proper multimeter probe placement on the sensor. For this example, your resistance reading is read from the top scale (OHMS) as shown in figure 4-17.

CHAPTER 5

UTILITY SYSTEMS

The utility systems of an aircraft provide an additional measure of flight safety, pilot comfort and convenience, and contribute to the overall mission capability of the aircraft. The bleed-air and liquid cooling utility systems are included in this chapter.

BLEED-AIR UTILITY SYSTEMS

Many aircraft have utility systems that rely on the bleed-air system to function. The P-3 deicing system, the A-6 rain removal system, and the T-2 anti-g and canopy seal systems are discussed in this chapter. This material will increase your proficiency in troubleshooting and maintaining these and similar systems.

DEICE SYSTEMS

An anti-icing system is designed to prevent ice from forming on the aircraft; whereas, a deicing system is designed to remove ice after it has formed. An aircraft deice system removes ice from propellers and the leading edges of wings and stabilizers. These systems may use electrical heaters, hot air, or a combination of both to remove the ice formation. As an AME, you are primarily concerned with hot air as a method to remove the formation of ice on wings and stabilizers. The P-3C wing deice system is used as an example in this chapter to describe a hot-air system.

Description

The P-3C wing deice system uses hot compressed bleed air from the engines. The air is ducted from the 14th stage of each engine compressor as shown in figure 5-1. The bleed air is maintained at a fixed percentage of engine airflow for all altitudes and flight speeds.

The hot bleed air is directed and regulated to the leading edge ejector manifold through shutoff valves, modulating valves, relief valves, thermostats, skin temperature sensors, and overheat warning sensors.

SHUTOFF VALVES.—The wing deice system contains several shutoff valves. The fuselage bleed-air shutoff valves installed in the cross-ship manifold, on the right and left wings, isolate the wings from the fuselage duct section. In addition, they may be used to isolate one wing duct from the other wing duct. Each valve is individually controlled by a guarded toggle switch mounted on the bleed-air section of the ice control protection panel.

A bleed-air shutoff valve is also installed in each engine nacelle. These shutoff valves are physically identical. They are of the butterfly-type, and they are actuated by an electric motor.

An indicator, located on top of the valve housing, shows the position of the valve: open or closed. This indicator enables you to visually check the operation of the valve while it is still installed in the deice system.

MODULATING VALVES.—The P-3C deicing system has three modulating valves installed in each wing. These valves are thermostatically controlled and pneumatically operated. They maintain the constant engine compressor bleed-air temperature required for the wing leading edge. When deicing is not required, the valves operate as shutoff valves.

The modulating valves, shown in figure 5-2, have pilot solenoid valves that are electrically

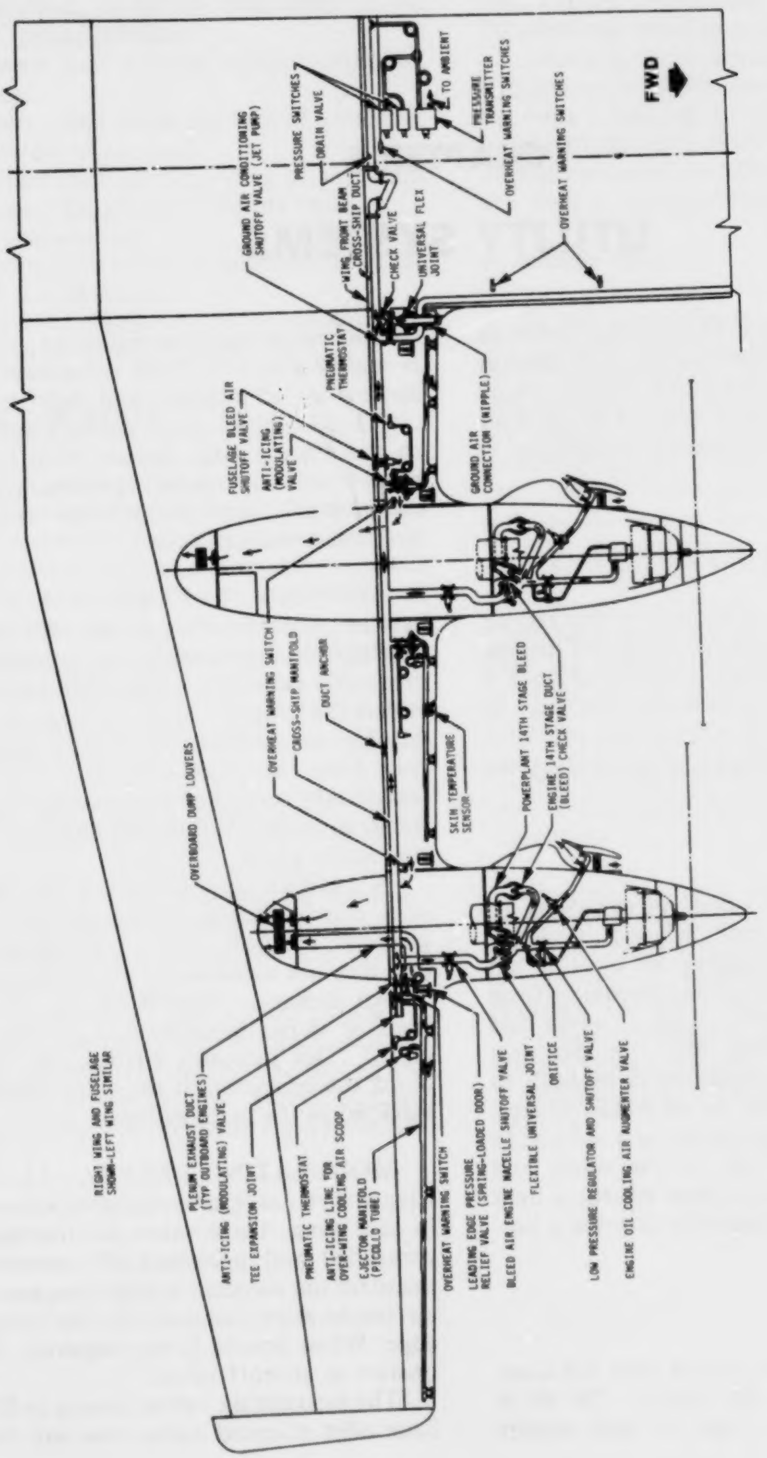

RIGHT WING AND FUSELAGE SHOWN—LEFT WING SIMILAR
PLENUM EXHAUST DUCT (TYP OUTBOARD ENGINES)
ANTI-ICING (MODULATING) VALVE
TEE EXPANSION JOINT
PNEUMATIC THERMOSTAT
ANTI-ICING LINE FOR OVER-WING COOLING AIR SCOOP
EJECTOR MANIFOLD (PICCOLO TUBE)
OVERHEAT WARNING SWITCH
LEADING EDGE PRESSURE RELIEF VALVE (SPRING-LOADED DOOR)
BLEED AIR ENGINE NACELLE SHUTOFF VALVE
FLEXIBLE UNIVERSAL JOINT
ORIFICE
LOW PRESSURE REGULATOR AND SHUTOFF VALVE
ENGINE OIL COOLING AIR AUGMENTER VALVE
OVERBOARD DUMP LOUVERS
OVERHEAT WARNING SWITCH
CROSS-SHIP MANIFOLD
DUCT ANCHOR
SKIN TEMPERATURE SENSOR
POWERPLANT 14TH STAGE BLEED
ENGINE 14TH STAGE DUCT (BLEED) CHECK VALVE
FUSELAGE BLEED AIR SHUTOFF VALVE
ANTI-ICING (MODULATING) VALVE
PNEUMATIC THERMOSTAT
GROUND AIR CONNECTION (NIPPLE)
GROUND AIR CONDITIONING SHUTOFF VALVE (JET PUMP)
WING FRONT BEAM CROSS-SHIP DUCT
CHECK VALVE
UNIVERSAL FLEX JOINT
PRESSURE SWITCHES
DRAIN VALVE
OVERHEAT WARNING SWITCHES
TO AMBIENT
PRESSURE TRANSMITTER
OVERHEAT WARNING SWITCHES
FWD

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Figure 5-1.—P-3C wing deicing system schematic.

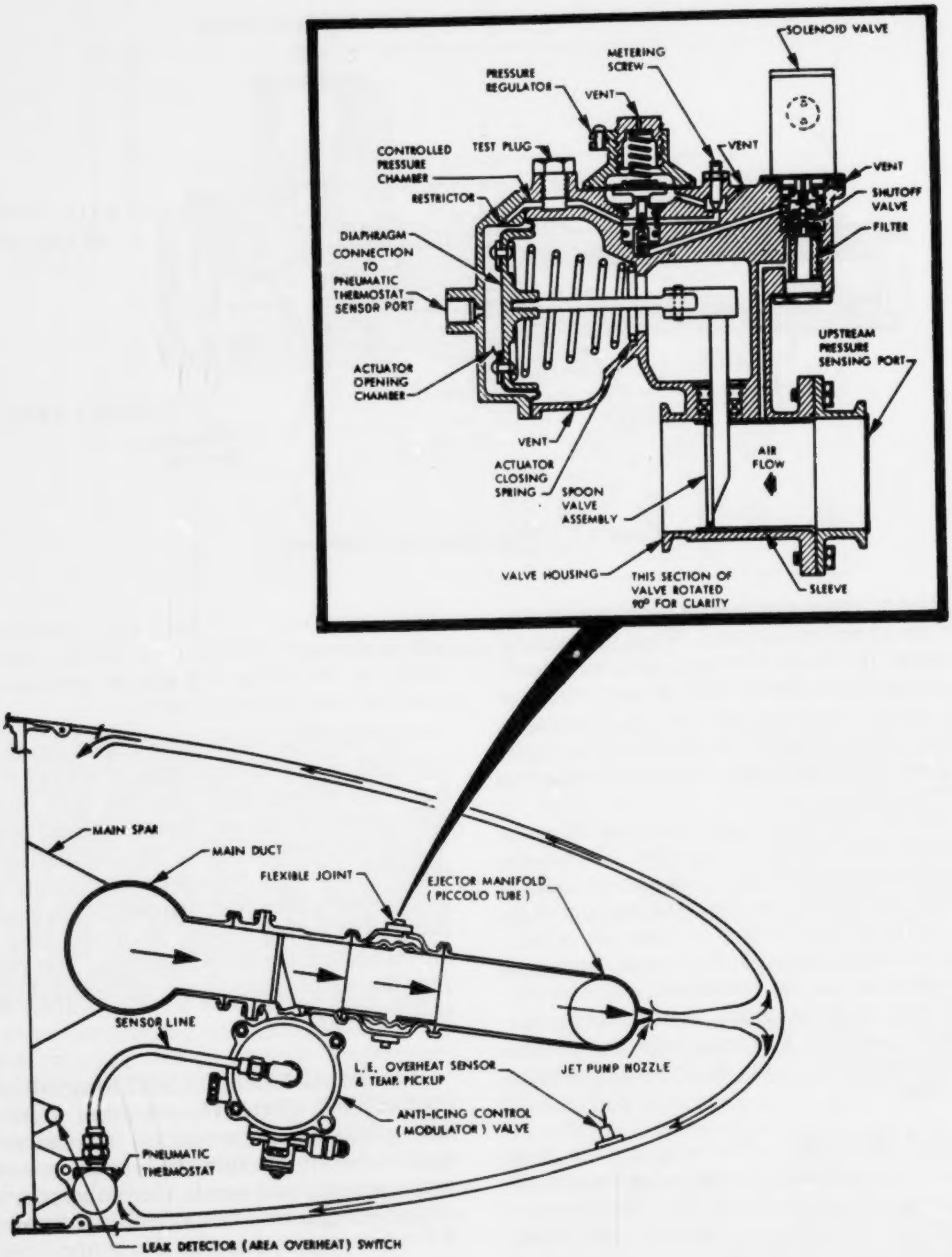
SOLENOID VALVE
METERING SCREW
PRESSURE REGULATOR
VENT
VENT
CONTROLLED PRESSURE CHAMBER
TEST PLUG
VENT
SHUTOFF VALVE
RESTRICTOR
FILTER
DIAPHRAGM
CONNECTION TO PNEUMATIC THERMOSTAT SENSOR PORT
UPSTREAM PRESSURE SENSING PORT
ACTUATOR OPENING CHAMBER
VENT
AIR FLOW
ACTUATOR CLOSING SPRING
SPOON VALVE ASSEMBLY
VALVE HOUSING
THIS SECTION OF VALVE ROTATED 90° FOR CLARITY
SLEEVE
MAIN SPAR
MAIN DUCT
FLEXIBLE JOINT
EJECTOR MANIFOLD (PICCOLO TUBE)
SENSOR LINE
JET PUMP NOZZLE
L.E. OVERHEAT SENSOR & TEMP. PICKUP
ANTI-ICING CONTROL (MODULATOR) VALVE
PNEUMATIC THERMOSTAT
LEAK DETECTOR (AREA OVERHEAT) SWITCH

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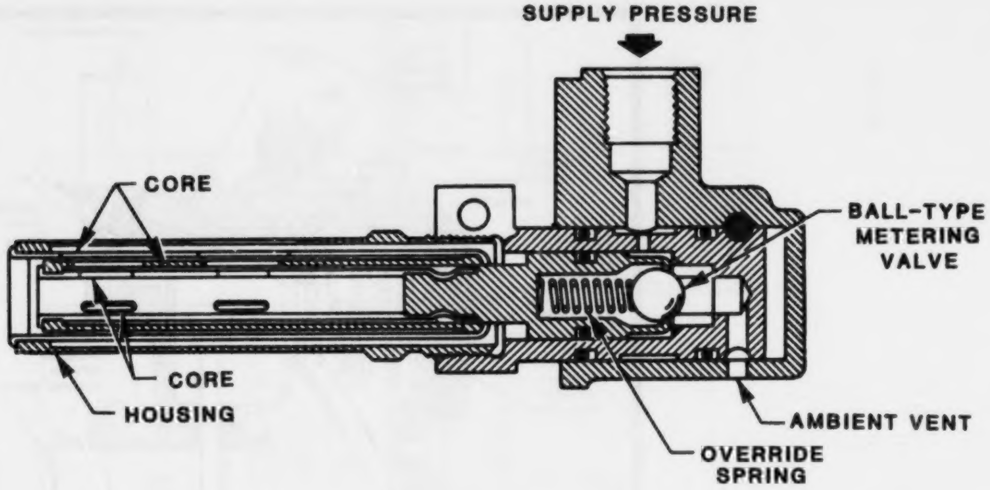
Figure 5-2.—Anti-icing modulating valve.



214.104

Figure 5-3.—Wing leading edge thermostat.

controlled by three switches on the bleed-air section of the ice protection panel. When the solenoid is energized, it admits filtered, regulated, bleed-air pressure to one side of a diaphragm chamber in the valve. The other side of the diaphragm chamber is spring-loaded to the closed position. Movement of the diaphragm operates a main line butterfly valve.

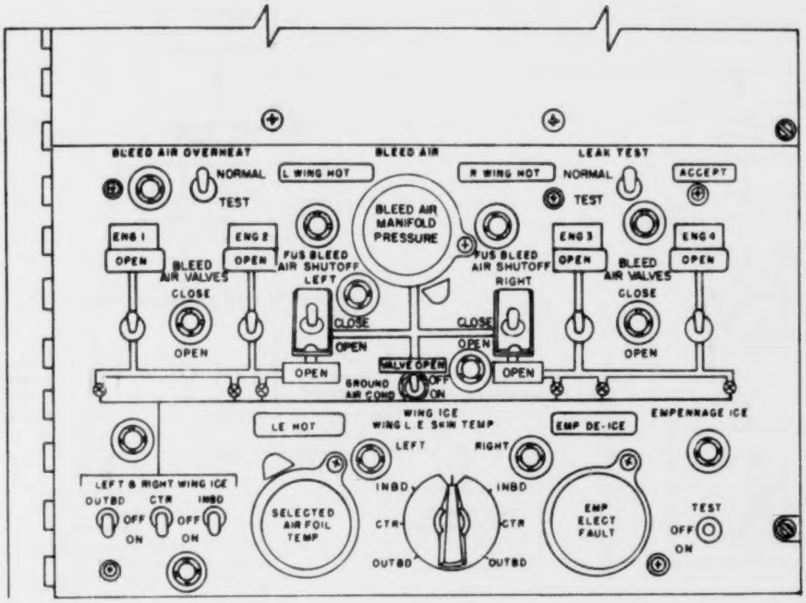
When the valve opens, hot air is admitted to the leading edge distribution system. The hot air goes through the modulator valve to the ejector manifold, out the jet nozzles, and into the wing leading edge plenum area. The bleed air is then directed across a pneumatic thermostat. Increased temperature across the thermostat actuates the sensor and opens a bleed passage from the diaphragm chamber. This reduces the pressure on the diaphragm and allows a spring to close the main valve.

THERMOSTATS.—The wing leading edge pneumatic thermostat is installed adjacent to each modulating valve. (See figure 5-2.) The thermostat controls air pressure on the modulating valve diaphragm and thereby controls the valve opening.

The unit is composed of a probe and a valve assembly. (See figure 5-3.) The probe is a core made of layers of high- and low-expansion material that is locked to a sliding piston. In addition, the piston contains an override spring and ball-type metering valve.

Airflow from the leading edge flows over the core and causes the materials to expand or contract. As temperature rises, the core pulls the piston and metering ball from the seated position. This allows pressure from the modulating valve diaphragm to vent. Increasing temperature causes more air to be bled from the diaphragm chamber. Because of spring action, the modulating valve moves toward the closed position. This restricts flow through the modulator valve and drops the skin temperature.

LEADING EDGE TEMPERATURE AND OVERHEAT CIRCUIT.—In order to monitor the overheat warning system, six skin temperature sensors (one in the inboard section, one in the center section, and one in the outboard section of each wing) form a part of an amplifier circuit. When the wing leading edge skin temperature rises in excess of 230°F at any one or more sensors, the airfoil temperature control unit amplifier completes a caution light circuit, thus illuminating the leading edge caution hot light.


BLEED AIR OVERHEAT
NORMAL
TEST
L WING HOT
BLEED AIR
R WING HOT
LEAK TEST
NORMAL
TEST
ACCEPT
BLEED AIR MANIFOLD PRESSURE
ENG 1
OPEN
ENG 2
OPEN
BLEED AIR VALVES
CLOSE
OPEN
FUS BLEED AIR SHUTOFF LEFT
CLOSE
OPEN
OPEN
FUS BLEED AIR SHUTOFF RIGHT
CLOSE
OPEN
OPEN
ENG 3
OPEN
ENG 4
OPEN
BLEED AIR VALVES
CLOSE
OPEN
VALVE OPEN
GROUND AIR COND
OFF
ON
LE HOT
WING ICE
WING L. E. SKIN TEMP
LEFT
RIGHT
EMP DE-ICE
EMPENNAGE ICE
LEFT & RIGHT WING ICE
OUTBD
CTR
INBD
OFF
ON
OFF
ON
SELECTED AIR FOIL TEMP
INBD
CTR
OUTBD
INBD
CTR
OUTBD
EMP ELECT FAULT
TEST
OFF
ON

214.105

Figure 5-4.—Ice control protection panel.

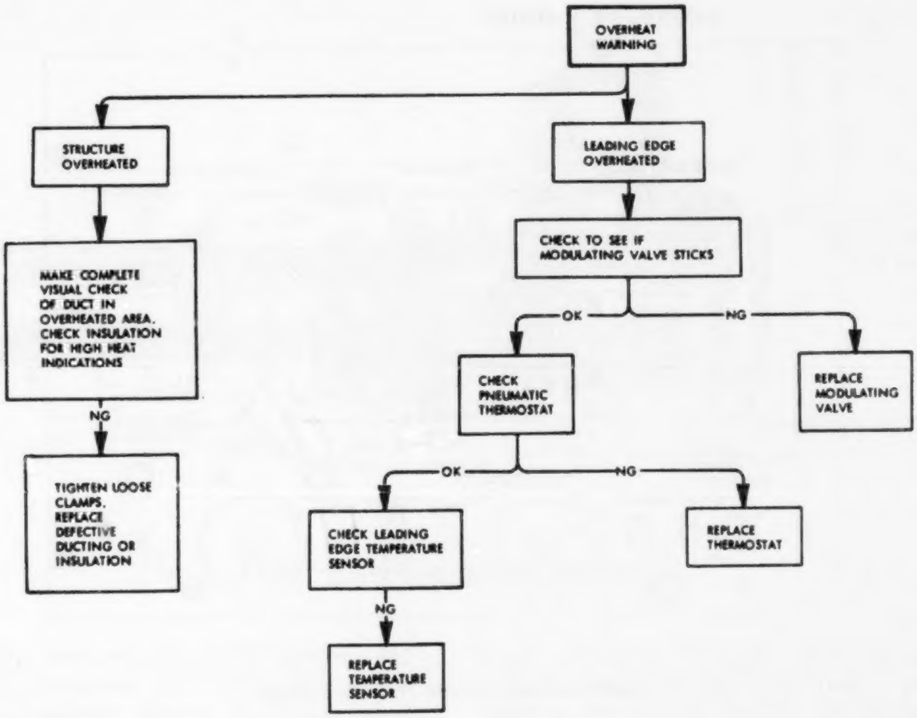
Also, there are three ducting overheat thermal switches installed in each wing and three installed in the fuselage adjacent to the bleed-air duct. These switches form a part of a loop that is connected to a signal light control assembly. When any one of the thermal leak detector switches closes, its respective caution light illuminates. Also, when the test switch is placed in the TEST position, both lights illuminate through their respective loop circuit.

The ducting overheat switches are single-pole, single-throw, explosive-proof, thermally actuated electrical switches with an integral temperature sensing element. The switches sense still air temperature. The outboard leading edge overheat warning switches open at approximately 205 °F and close at approximately 220 °F. The other wing and fuselage overheat warning switches open at approximately 175 °F and close at approximately 190 °F.

High temperature within the leading edge is generally caused by bleed-air leakage or malfunctioning modulator valves. You can detect the portion of the leading edge that has the overtemperature by placing the rotary selector switch, located on the ice control protection panel, to the different sensor positions: INBD, CTR, and OUTBD. (See figure 5-4.) The temperature at the selected sensor is then read at the indicator adjacent to the rotary switch. An excessive temperature reading on the indicator denotes a malfunction within the area being tested.

Operation

Figure 5-4, the ice control protection panel, shows a basic diagram of the wing deice system. Each engine is labeled by an engine number. Directly below each engine block in the diagram is an OPEN light that illuminates when the bleed-air valve is open 2° or more. The cross-ship manifold from the bleed-air valves goes to each modulating valve and the fuselage shutoff valves. The fuselage bleed-air shutoff valves are normally in the CLOSE position during normal deicing operation. The bleed-air pressure gage reads cross-ship manifold pressure when one or both switches are opened.


OVERHEAT WARNING
STRUCTURE OVERHEATED
LEADING EDGE OVERHEATED
CHECK TO SEE IF MODULATING VALVE STICKS
MAKE COMPLETE VISUAL CHECK OF DUCT IN OVERHEATED AREA. CHECK INSULATION FOR HIGH HEAT INDICATIONS
OK
NG
CHECK PNEUMATIC THERMOSTAT
REPLACE MODULATING VALVE
NG
OK
NG
TIGHTEN LOOSE CLAMPS. REPLACE DEFECTIVE DUCTING OR INSULATION
CHECK LEADING EDGE TEMPERATURE SENSOR
REPLACE THERMOSTAT
NG
REPLACE TEMPERATURE SENSOR

214.145

Figure 5-5.—Deicing troubleshooting chart.

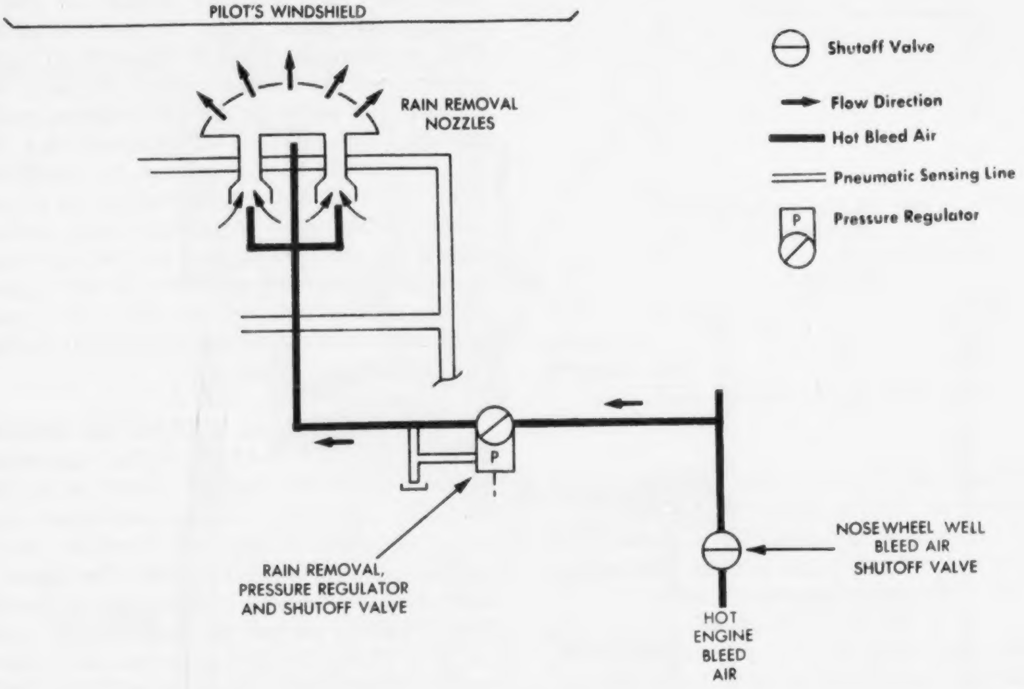
A ground air-conditioning switch is located directly under the bleed-air manifold pressure gage. Located above the switch is an annunciator light, which indicates VALVE OPEN when the ground air-conditioning valve is open. Either one or both fuselage bleed-air shutoff valves must be open to direct air to the ground air-conditioning unit.

A leak test switch is mounted on the upper right-hand side of the panel. This switch is used to determine if the leakage of the system is acceptable or not.

Three modulating valve control switches are located on the left side of the wing and empennage ice panel. The outboard switch controls the outboard modulating valve on the left and right wing, the center switch controls the two center modulating valves, and the inboard switch controls the two inboard modulating valves.

During normal operation of the deicing system, all four engine bleed-air valves are open to supply bleed air to the cross-ship manifold, and both fuselage bleed-air shutoff valves are closed. The modulating valves maintain a controlled flow of bleed air to the leading edge distribution system, and they are controlled by pneumatic thermostats. The complete system is monitored for hot spots by heat sensing switches.

Before flight, the deicing manifold system may be tested for leakage. This leak test is performed by pressurizing the system: OPEN the number 4 engine bleed-air valve; the numbers 1, 2, and 3 engine bleed-air valves remain CLOSED, and both fuselage shutoff valves are in the OPEN position. When the bleed-air pressure on the bleed-air manifold reads 70 psi, the number 4 engine bleed-air valve is closed and the leak test switch is actuated. As the bleed-air pressure drops, the time-delay relay will illuminate the ACCEPT


PILOT'S WINDSHIELD
RAIN REMOVAL NOZZLES
Shutoff Valve
Flow Direction
Hot Bleed Air
Pneumatic Sensing Line
P
Pressure Regulator
P
RAIN REMOVAL, PRESSURE REGULATOR AND SHUTOFF VALVE
NOSEWHEEL WELL BLEED AIR SHUTOFF VALVE
HOT ENGINE BLEED AIR

214.160

Figure 5-6.—Rain removal system.

light after an 8-second delay if the system is tight. The light will go out when the test switch is released.

Maintenance

The involvement of the AME1 and AMEC in the maintenance of the deicing system normally consists of troubleshooting. To troubleshoot intelligently, you must be familiar with the system. In addition, you must know the function of each component in the system and have a mental picture of the location of each component in relation to other components in the system. This can be achieved by studying the schematic diagrams of the system.

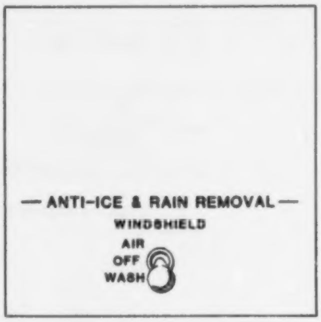
As an aid, the aircraft manufacturer furnishes troubleshooting charts, which give recommended procedures to follow during troubleshooting. Figure 5-5 shows a deicing system overheat warning troubleshooting chart. This chart lists the most probable cause first and then branches to the next most probable cause. By following the recommended charts and procedures, you can save many valuable maintenance hours.

RAIN REMOVAL SYSTEM

The rain removal system shown in figure 5-6 controls windshield icing and removes rain by directing a flow of heated air over the windshield. This heated air serves two purposes. First, the air breaks the rain drops into small particles, which are then blown away. Secondly, the air heats the windshield to prevent the moisture from freezing on it. The A-6E rain removal system, for those aircraft with airframes change number 268 incorporated, is discussed in the following paragraphs.

Description

The rain removal system is controlled by the windshield switch located on the air-conditioning



214.161

Figure 5-7.—Air-conditioning panel.

control panel in the cockpit. (See figure 5-7.) The system uses hot bleed air from the 12th stage compressor section of each engine. The nosewheel well bleed-air shutoff valve controls the flow of hot bleed air to the rain removal system.

Then the rain-removal, pressure-regulator shutoff valve controls the airflow from the rain-removal system to the windshield. When this valve is open, it allows hot bleed air to flow to the rain-removal nozzle assembly. The nozzle distributes the air through a series of diffuser outlets to form a wide stream of hot air over the windshield. The temperature of the air is lowered by a mixing ejector at the inlet of the rain-removal nozzle assembly. The ejector utilizes hot bleed air as its primary air and draws secondary air from the nose radome compartment to cool the rain-removal air.

Components

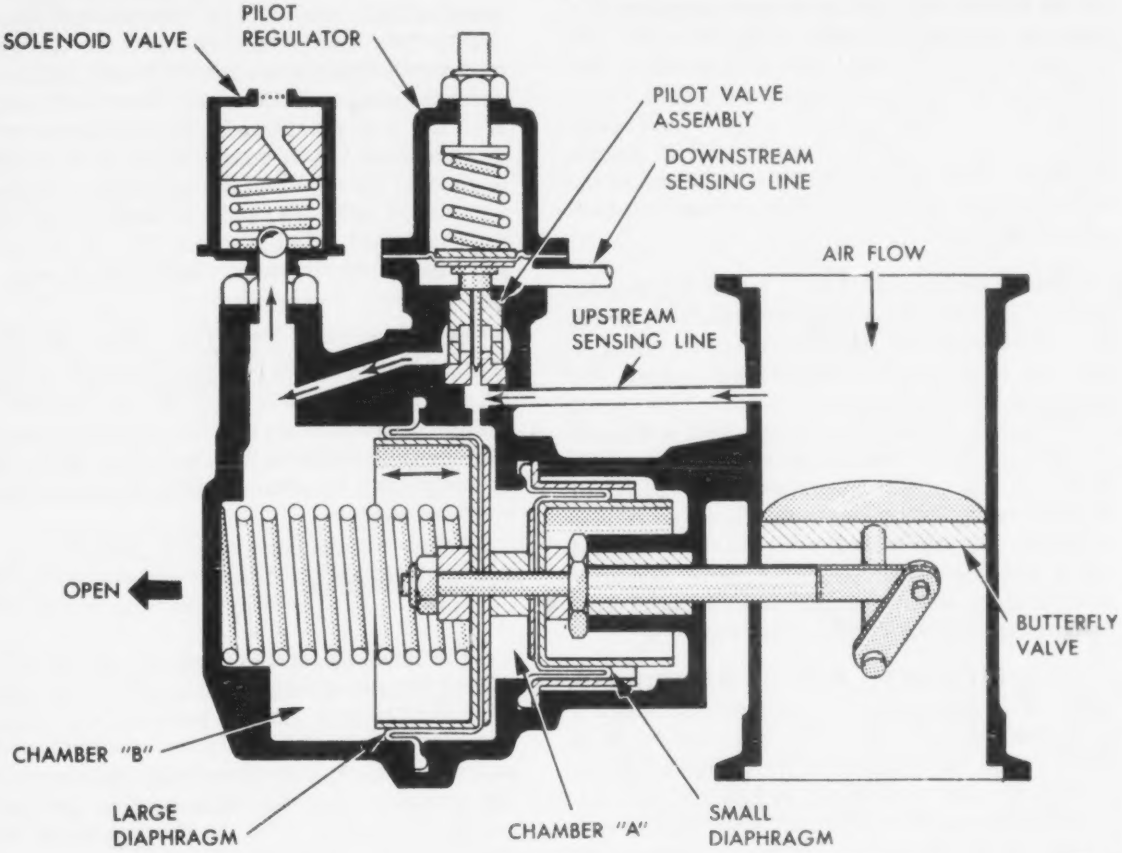
In the next several paragraphs, we will discuss the major components of the rain removal system. You should know the location and functions of these components to aid you in troubleshooting and maintaining the system.

NOSEWHEEL WELL BLEED-AIR SHUTOFF VALVE.—The nosewheel well bleed-air shutoff valve is a butterfly-type that is electrically actuated and operated. The valve is installed in the hot bleed-air duct in the starboard engine compartment. The valve is controlled by the nosewheel well bleed-air switch on the fuel management panel. When the switch is set to the OFF position, the valve is closed by 115-volt ac power from the bleed-air circuit breaker. When the switch is set to the AUTO position, power is routed to the nosewheel well bleed-air relay. When the windshield switch on the air-conditioning panel is moved to the AIR position, or when left main landing gear weight-on-wheels switch is closed, the relay is activated and the valve opens. If electric power is lost, the valve will remain in the last selected position. The valve has a position indicator which can be viewed with the starboard engine-bay door open.

RAIN-REMOVAL PRESSURE-REGULATOR SHUTOFF VALVE.—The rain-removal pressure-regulator shutoff valve is a pneumatically operated, solenoid-controlled, 2-inch valve installed in the hot bleed-air duct to the rain-removal nozzle assembly. (See figure 5-8.) Operation of the valve is controlled by the windshield switch on the air-conditioning control panel. Placing the switch to the AIR position energizes the solenoid of the valve. When the inlet pressure to the valve is between 15 and 50 psi, the valve is fully opened. When it is between 100 and 250 psi, the valve regulates the outlet pressure to the rain-removal nozzle at 75 ± 3.5 psi. By placing the windshield switch to OFF, it de-energizes the solenoid. This causes the valve to close and shuts off the flow of bleed air to the rain-removal nozzle.

In the closed position, air from the upstream side of the valve passes through the control air passages to chamber A and leaks past the pilot valve stem to chamber B. With equal pressure on both sides of the large diaphragm, the pressure on the small diaphragm and the spring force on top of the large diaphragm combine to hold the valve closed.

When the solenoid is energized, air supplied to chamber B bleeds off through the solenoid and the butterfly valve opens. As the butterfly valve opens, air pressure from the downstream side of the valve is applied to the bottom of the pilot regulator diaphragm. This unseats the regulator valve stem and permits upstream air to flow to chamber B. As the downstream pressure varies,


SOLENOID VALVE
PILOT REGULATOR
PILOT VALVE ASSEMBLY
DOWNSTREAM SENSING LINE
AIR FLOW
UPSTREAM SENSING LINE
OPEN
BUTTERFLY VALVE
CHAMBER "B"
LARGE DIAPHRAGM
CHAMBER "A"
SMALL DIAPHRAGM

214.162

Figure 5-8.—Rain-removal Pressure-regulator shutoff valve.

a varying amount of air is metered by the pilot regulator valve to chamber B. The metering positions the diaphragm and the butterfly valve to maintain the proper downstream pressure. If the downstream pressure increases to a value in excess of the regulator setting, the pilot valve opens. When this occurs, the solenoid valve is not capable of bleeding off the increased airflow in chamber B. Therefore, chamber B pressure increases and the butterfly valve moves toward the closed position until regulation pressure is reached.

RAIN-REMOVAL NOZZLE ASSEMBLY.—The rain-removal nozzle assembly consists of two ejectors, a plenum chamber, and 26 nozzles. The bleed-air duct has two nozzles aligned with and located beneath each ejector tube. The ejectors mix cool air from the nose radome compartment with the hot bleed air. The mixture is distributed by the plenum to the nozzles, which results in a wide stream of air across the windshield. The plenum chamber provides an approximately equal pressure at each nozzle. The rain-removal nozzle assembly is beneath the left windshield.

WINDSHIELD SWITCH.—The windshield switch is a single-pole, three-position switch mounted on the air-conditioning control panel in the cockpit. The three positions are OFF, AIR, and WASH. This switch controls the operation of the windshield-washing shutoff valve and rain-removal pressure-regulator shutoff valve. The switch is spring-loaded to the OFF position. The AIR and WASH positions are momentary contacts. If the switch is placed to the WASH position, it directs streams of washing fluid against the base of the windshield. If it is placed to the AIR position, it directs a wide stream of hot air across the glass.

NOSEWHEEL WELL BLEED-AIR SWITCH.—The nosewheel well bleed-air switch is a single-pole, two-position switch mounted on the fuel management panel in the cockpit. The two positions are OFF and AUTO. This switch controls the operation of the nosewheel well bleed-air shutoff valve. Placing the switch to the OFF position closes the nosewheel well bleed-air shutoff valve. When the switch is set to AUTO position, the nosewheel well bleed-air shutoff valve will open when the rain-removal system is energized or when the left main landing gear weight-on-wheels switch is actuated.

NOSEWHEEL WELL BLEED-AIR RELAY.—The nosewheel well bleed-air relay is a double-pole, double-throw, relay mounted in aft bay relay box number 3. Its operation is controlled by the windshield switch on the air-conditioning panel or by the left main landing gear weight-on-wheels switch. When energized, the relay completes a 115-volt ac circuit to open the nosewheel well bleed-air shutoff valve. When deenergized, the relay completes a 115-volt ac circuit to close the nosewheel well bleed-air shutoff valve.

LEFT MAIN LANDING GEAR WEIGHT-ON-WHEELS SWITCH.—The left main landing gear weight-on-wheels switch is a double-pole, double-throw switch mounted on the lower torque arm of the left gear shock strut. The switch is closed when the shock strut piston is extended. When the shock strut piston is compressed, the plunger of the switch is fully extended. When the switch plunger is extended, a 28-volt dc circuit is completed to energize the nosewheel well bleed-air relay.

WINDSHIELD RAIN-REMOVAL WARNING RELAY.—The windshield rain-removal warning relay is a double-pole, double-throw, sealed relay mounted in the cockpit center console below the wing fold panel. Its operation is controlled by the windshield switch on the air-conditioning panel. When the windshield switch is in the AIR position, 28 volts of dc power is directed from the air-conditioning circuit breaker to energize the relay and illuminate the windshield air caution light. The relay is deenergized when the windshield switch is set to OFF. At this time, the windshield air caution light will go out.

WINDSHIELD AIR CAUTION LIGHT.—The windshield air caution light is one of the lights on the caution lights panel in the cockpit. It illuminates to indicate that the windshield switch is in the AIR position. The operation of the light is controlled by the windshield rain-removal warning relay.

System Operation

The rain-removal system is activated by placing the windshield switch to the AIR position. With the switch in the AIR position, a 28-volt dc circuit is completed from the air-conditioning circuit breaker, through the windshield switch, to the solenoid of the rain-removal pressure-regulator shutoff valve, to the nosewheel well bleed-air relay, and to the windshield rain-removal warning relay. When the nosewheel well bleed-air relay is energized, the 115-volt ac circuit from the bleed-air circuit breaker, through the AUTO position of the nosewheel well bleed-air switch, is completed to the open windings of the nosewheel well bleed-air shutoff valve. With the circuit completed, the windshield air caution light will illuminate. When you move the windshield switch to the OFF position, the windshield air caution light will go out. The nosewheel well bleed-air shutoff valve directs the 115-volt ac power to the close windings of the motor. The weight-on-wheels switch will energize the nosewheel well bleed-air relay.

When the rain-removal pressure-regulator shutoff valve solenoid is energized, the valve opens and allows pressure-regulated (75 ± 3.5 psi) hot bleed air to flow to the ejectors of the rain-removal nozzles. To lower the temperature of the hot bleed air, the ejectors draw cool air from the nose radome compartment. The cool air and hot bleed air mix in the plenum of the nozzle assembly. The air passes through the plenum to 26 nozzles, which direct the hot air in a wide stream across the windshield.

ANTI-G SYSTEMS

An anti-g system supplies and controls the flow of air pressure to the pilot's anti-g suit to compensate for forces exerted upon the human body during flight conditions. This system is designed to accomplish the following:

1. Provide protection against greyout, blackout, and unconsciousness.

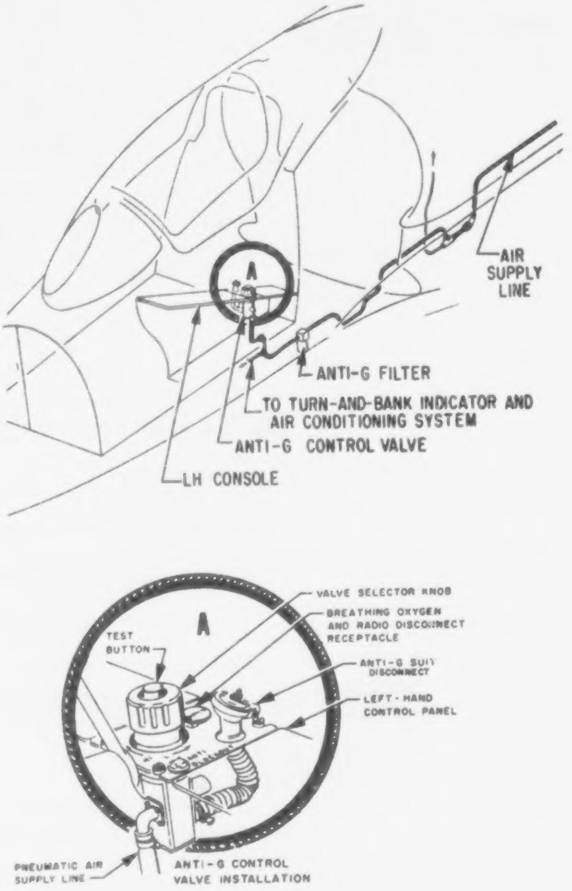
2. Alleviate fatigue and decreased mental alertness which may result from repeated accelerations below the blackout level.

3. Provide a method by which the pilot may relieve leg stiffness and physical tension during flight.

4. Provide the pilot with a physical indication of the approximate acceleration to which the aircraft is being subjected.

Typical Anti-g System

The anti-g system used in most aircraft is similar to the one shown in figure 5-9. This system consists of a supply line, an air filter, a pressure regulating valve, a connecting hose, and a suit attachment fitting (single quick disconnect or composite quick disconnect). The air pressure used in this system may be taken directly from the engine compressor bleed-air ducting, but it is usually taken from the air-conditioning ducting downstream from the heat exchanger.

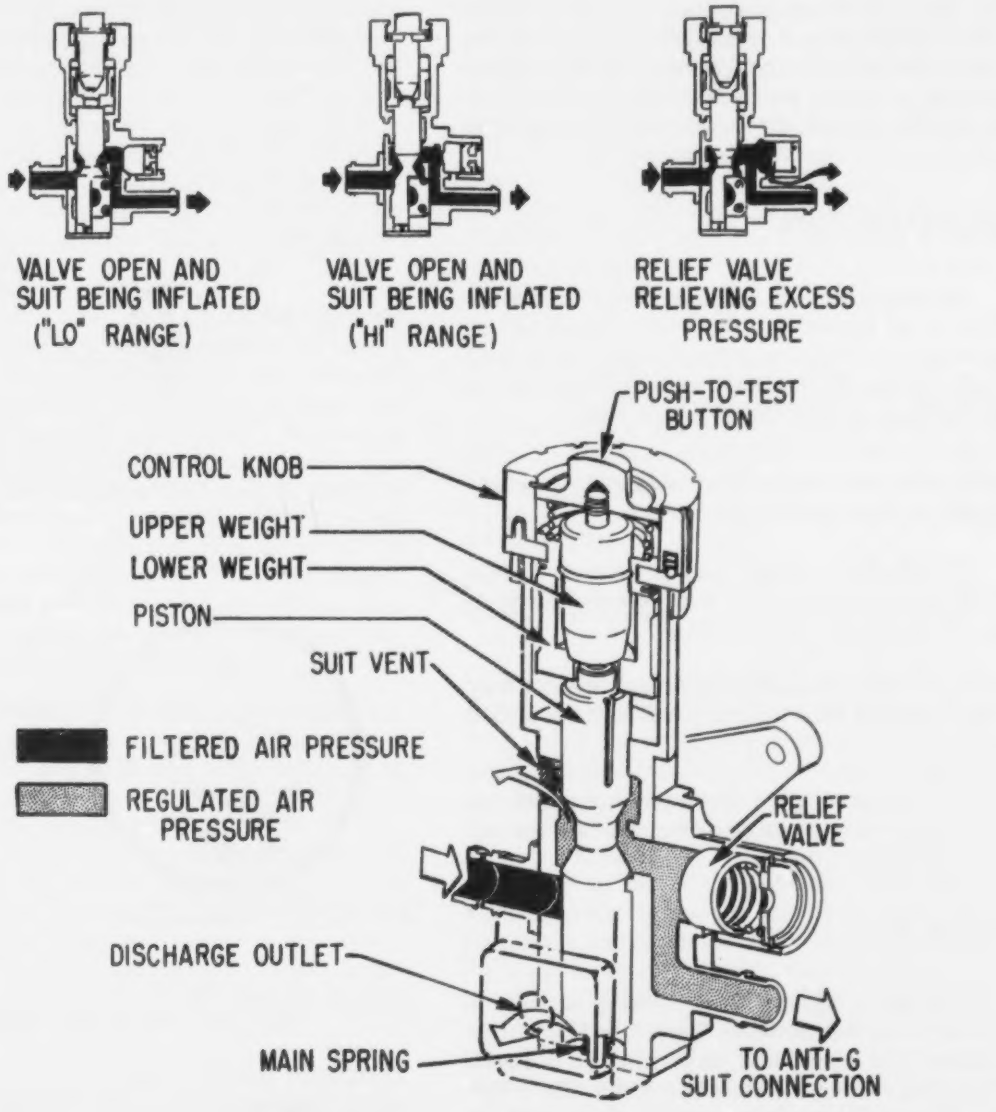

A
AIR SUPPLY LINE
ANTI-G FILTER
TO TURN-AND-BANK INDICATOR AND AIR CONDITIONING SYSTEM
ANTI-G CONTROL VALVE
LH CONSOLE
A
TEST BUTTON
VALVE SELECTOR KNOB
BREATHING OXYGEN AND RADIO DISCONNECT RECEPTACLE
ANTI-G SUIT DISCONNECT
LEFT-HAND CONTROL PANEL
PNEUMATIC AIR SUPPLY LINE
ANTI-G CONTROL VALVE INSTALLATION

214.133

Figure 5-9.—Typical anti-g system.

PRESSURE REGULATING (ANTI-G) VALVES.—There are two types of anti-g valves on naval aircraft. One type has a dual pressure range (HI or LO) which may be controlled by the pilot. The other type has a fixed pressure output which corresponds roughly to the high (HI) pressure output of the dual pressure valve. Both valves perform the dual functions of regulating the air pressure received from the aircraft bleed-air system and metering this pressure in varying amounts proportional to the g forces exerted upon the aircraft and its occupants.

ANTI-G VALVE (AN6538-2).—This dual range pressure regulating valve is a standard stock item which may be used on several different types of aircraft. In some cases, it is necessary to modify this valve, as required by the applicable


VALVE OPEN AND
SUIT BEING INFLATED
("LO" RANGE)
VALVE OPEN AND
SUIT BEING INFLATED
("HI" RANGE)
RELIEF VALVE
RELIEVING EXCESS
PRESSURE
PUSH-TO-TEST
BUTTON
CONTROL KNOB
UPPER WEIGHT
LOWER WEIGHT
PISTON
SUIT VENT
■ FILTERED AIR PRESSURE
▨ REGULATED AIR PRESSURE
RELIEF
VALVE
DISCHARGE OUTLET
MAIN SPRING
TO ANTI-G
SUIT CONNECTION

214.134

Figure 5-10.—Anti-g valve (dual range).

maintenance instructions manual, to adapt it to a particular aircraft.

A knob on the top of the valve controls the pressure output. The knob is rotated to select either HI or LO pressure output. (See figure 5-10.) A button on top of the valve allows the pilot to test the operation of the system. Also, pressing this button from time to time during flight produces a massaging effect that will relieve the pilot's leg stiffness and physical tension.

When the control knob is set at LO, the valve opens at approximately 1.75 g's and then, subsequently, allows 1 psi air pressure to pass to the suit for each additional increment of 1 g. For example, at 3 g's the valve allows 1.87 psi air pressure to pass to the suit.

When accelerations decrease below 1.75 g's, the valve closes and exhausts the suit pressure into the cabin atmosphere, thus allowing the suit to deflate.

Anti-G System Filter

Most anti-g systems use a filter to prevent particles of dust, trash, and other foreign material from entering the regulating valve. This filter may be located in the supply line, as shown in figure 5-9, or it may be attached to the anti-g valve on the inlet side. A typical anti-g system filter is shown in figure 5-11.

Quick Disconnects

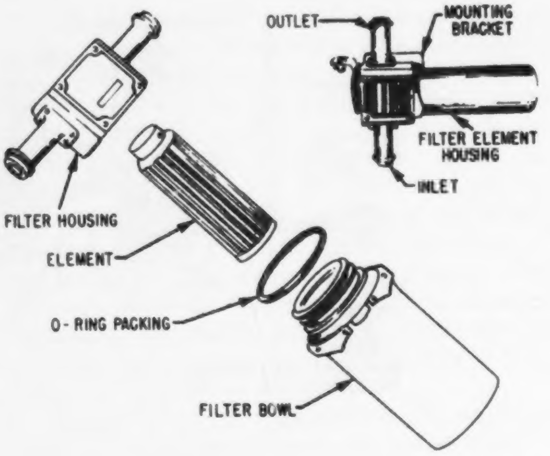
The disconnect used for connecting the anti-g suit to the anti-g system may be either the single quick disconnect or the composite quick disconnect.

The anti-g system quick disconnect is designed to provide a quick method of connecting and disconnecting the pilot's anti-g suit to the anti-g system. In some installations, the quick disconnect protrudes through the pilot's console and is attached by a flexible hose to the outlet port of the anti-g pressure regulating valve. The disconnect can be pulled up to a bumper stop on the hose to make the connection to the anti-g suit. A spring-loaded cover prevents the entry of foreign matter when the disconnect is not being used. (See figure 5-9.)

Anti-g System Maintenance

Maintenance of the anti-g system consists mainly of removal and installation of valves and lines and servicing the filter. Component repair of the anti-g valve is limited because of the equipment necessary to test the valve. Component repair of the dual range anti-g valve is not recommended. The single-stage anti-g valve may be repaired at intermediate maintenance activities that have the necessary test equipment.

SERVICING.—The anti-g filter element should be replaced at periodic intervals, or when the element becomes clogged or dirty. The replacement interval is specified in the applicable maintenance requirement cards. If the filter is removed from the aircraft to replace the filter element, you should ensure the filter is reinstalled properly. (The inlet and outlet ports are identified as IN and OUT to facilitate installation for proper direction of airflow.) After replacing the filter element, a thorough check should be made to ensure that no air leaks exist.



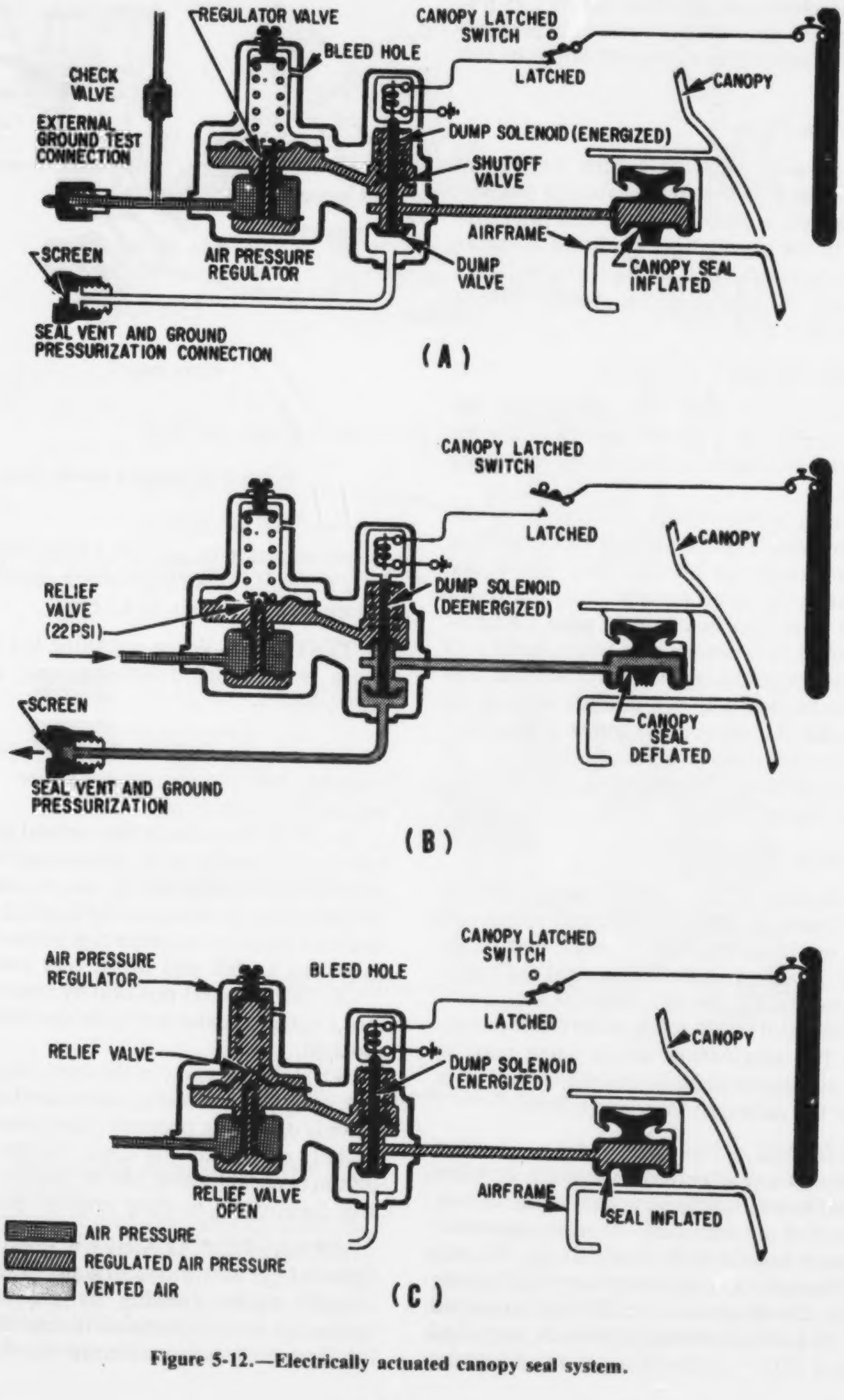
213.111

Figure 5-11.—Anti-g system filter.

TESTING.—When installing the dual range anti-g valve, the following test should be performed:

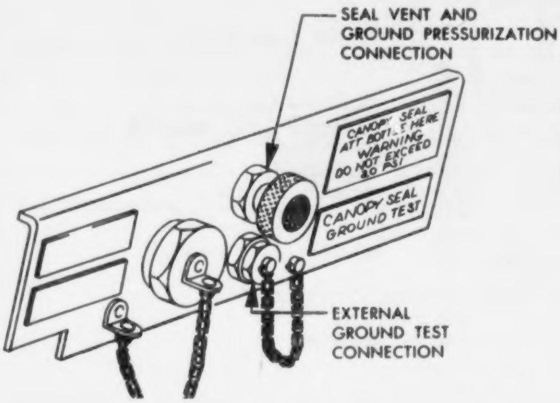
1. Select the LO position by rotating the control knob counterclockwise until the mechanical stop is reached.
2. Hold the valve in the vertical position and give it a sudden forceful, downward shake. If the valve is operating properly, the piston and lower weight inside the valve can be heard to drop down and then return to its original position. This movement can be felt and heard very easily.
3. Select the HI position by rotating the control knob clockwise until the mechanical stop is reached.
4. Hold the valve in the vertical position and give it a sudden forceful, downward shake. If the valve is operating properly, the piston and lower weight, as well as the upper weight and push-button inside the valve, can be heard to drop down and then return to their original positions.

OPERATIONAL CHECK.—An operational check of the anti-g system is performed with the aircraft engine running by pressing the test button on top of the valve to determine if there is proper airflow from the system. When the test


REGULATOR VALVE
CANOPY LATCHED SWITCH
BLEED HOLE
CHECK VALVE
LATCHED
CANOPY
EXTERNAL GROUND TEST CONNECTION
DUMP SOLENOID (ENERGIZED)
SHUTOFF VALVE
AIRFRAME
SCREEN
AIR PRESSURE REGULATOR
DUMP VALVE
CANOPY SEAL INFLATED
SEAL VENT AND GROUND PRESSURIZATION CONNECTION
(A)
CANOPY LATCHED SWITCH
LATCHED
CANOPY
RELIEF VALVE (22 PSI)
DUMP SOLENOID (DEENERGIZED)
SCREEN
CANOPY SEAL DEFLATED
SEAL VENT AND GROUND PRESSURIZATION
(B)
AIR PRESSURE REGULATOR
BLEED HOLE
CANOPY LATCHED SWITCH
LATCHED
CANOPY
RELIEF VALVE
DUMP SOLENOID (ENERGIZED)
AIRFRAME
RELIEF VALVE OPEN
SEAL INFLATED
AIR PRESSURE
REGULATED AIR PRESSURE
VENTED AIR
(C)

213.105

Figure 5-12.—Electrically actuated canopy seal system.


SEAL VENT AND GROUND PRESSURIZATION CONNECTION
CANOPY SEAL ATT BOTTLE HERE WARNING DO NOT EXCEED 20 PSI
CANOPY SEAL GROUND TEST
EXTERNAL GROUND TEST CONNECTION

214.139

Figure 5-13.—Cabin air pressure test panel.

button is depressed, the amount of airflow from the disconnect should be proportional to the amount the button is depressed. Greater airflow with increased button depression indicates that the anti-g valve is operating properly. On aircraft with the dual range anti-g valve, this test should be performed in both the high (HI) and low (LO) range.

CANOPY SEAL SYSTEM

An electrically actuated canopy pressure seal system is shown in figure 5-12. This type of system is controlled by a pressure regulator and dump valve assembly, which consists of a pressure regulator, a solenoid poppet shutoff and vent valve, and a relief valve.

Canopy Pressure Seal Regulator Valve

The canopy pressure seal regulator valve controls the pressurizing and depressurizing of the canopy seal, depending upon the canopy position. The pressure regulator consists of a spring-loaded diaphragm which controls a poppet valve to admit the correct air pressure to the canopy seal. An adjustment screw is provided at the top of the regulator housing to adjust the output of air pressure.

The shutoff and dump valve consists of a solenoid-operated poppet valve, which is spring-loaded to the closed position. When the solenoid is energized (figure 5-12, view A), the dump valve closes the vent port and opens the regulator shutoff to permit inflation of the canopy seal. The outlet pressure is maintained at approximately 20 psi by the pressure regulator.

When the solenoid is deenergized by the opening of the canopy (figure 5-12, view B), the dump valve opens the vent port, closes the regulator shutoff to stop the flow of supply air, and dumps the pressure in the seal overboard through the vent line. The relief valve feature of the pressure regulator prevents seal pressure from becoming excessive during rapid altitude changes by venting the seal pressure overboard when the pressure reaches a maximum of 22 psi (figure 5-12, view C).

In case of an electrical failure, the regulator valve is spring-loaded in the dump position.

Ground Test Connections

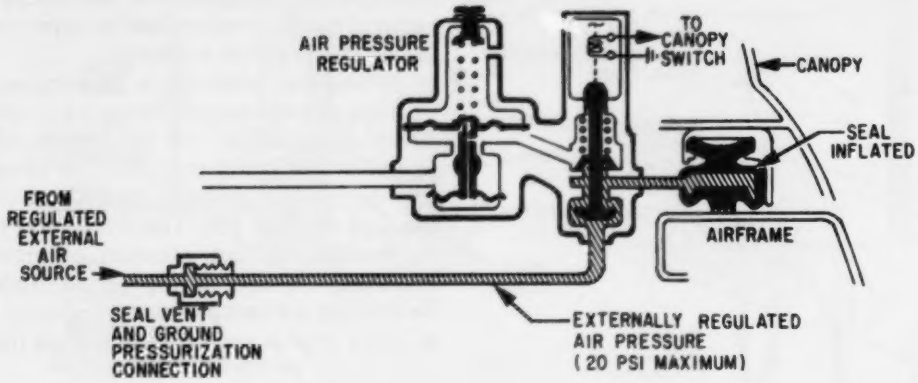
Most canopy pressure seal systems have ground test connections that are used to ground test the system and to pressurize the system during carrier deck storage. The ground test connections, shown in figure 5-13, are usually located on the cabin air pressure test panel. One connection is utilized for ground test; and the other, which is normally the seal vent, is used for ground pressurization of the canopy seal.

Maintenance

Maintenance of the electrically actuated system, like the mechanical system, consists of servicing, troubleshooting, and removal and installation of components. The applicable aircraft maintenance instructions manual furnishes such information as proper procedure, manpower requirements, materials lists, tool and equipment lists, quality assurance instructions, and maintenance-level instructions for the disposition of the defective parts.

SERVICING.—Servicing is limited to cleaning the canopy seal, ground inflating the canopy seal, and periodic inspections for visible defects, dirt, and foreign material accumulations. All major components of the system are self-sustaining and require no general servicing between overhaul periods for normal operation.

When pressurized aircraft are stowed on the carrier flight deck without canopy covers, the canopy seal should be inflated externally to


AIR PRESSURE REGULATOR
TO CANOPY SWITCH
CANOPY
SEAL INFLATED
FROM REGULATED EXTERNAL AIR SOURCE
AIRFRAME
SEAL VENT AND GROUND PRESSURIZATION CONNECTION
EXTERNALLY REGULATED AIR PRESSURE (20 PSI MAXIMUM)

214.140

Figure 5-14.—Ground inflation of the canopy seal system.

protect the cabin area. Ground pressurization of the canopy seal is accomplished by attaching an external air source to the canopy seal vent and ground pressurization fitting. (See figure 5-14.) Since air pressure applied to this fitting bypasses the system regulator, the air source must be controlled to less than 20 psi. More than 20 psi pressure could rupture the seal.

TROUBLESHOOTING.—Troubleshooting charts similar to the one in table 5-1 are found in most aircraft maintenance instructions manuals. The troubleshooting chart is provided as an aid in determining the cause, isolation procedure, and remedy for the more common malfunctions within the canopy seal system. When a malfunction is suspected, always ensure that the proper controls have been activated to provide proper operating potential to the unit to be inspected.

REMOVAL AND INSTALLATION PROCEDURES.—The aircraft maintenance instructions manual provides the instructions and visual aids necessary to remove and install the various components of the canopy seal system. In addition to instructions, information such as disposition of defective parts, tools and equipment requirements, and quality assurance instructions is provided. When removing a unit from the aircraft, always ensure that proper measures are taken to prevent the entry of dirt and foreign material into ports and ducts that have been opened to accommodate removal.

ONBOARD OXYGEN GENERATING SYSTEM

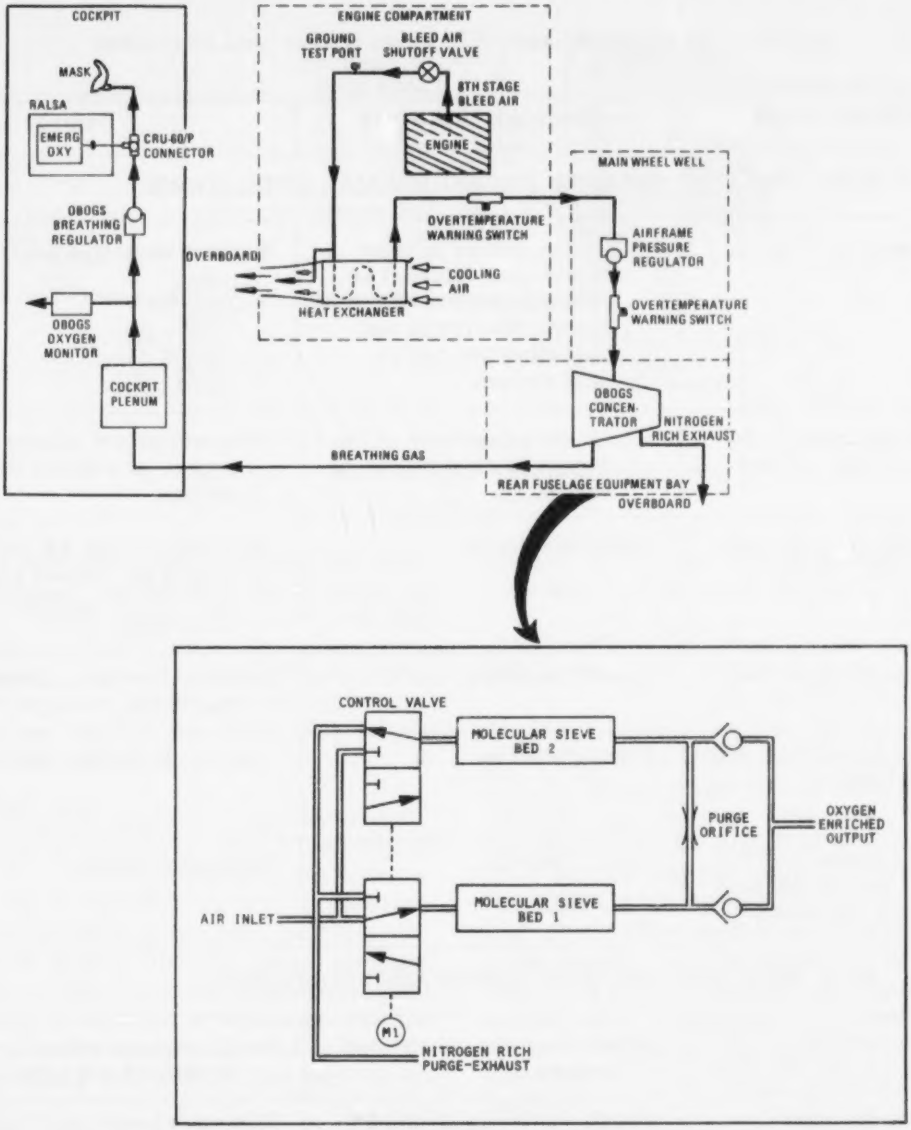
The onboard oxygen generating system (OBOGS) is an alternative to liquid oxygen (LOX). When compared to a LOX system, the OBOGS has several advantages. First, its availability may be as high as 99 percent. There is no requirement for depot-level maintenance. The OBOGS has no daily service requirements, and scheduled preventive maintenance occurs at 2,000 hours. Incorporation of the OBOGS eliminates the need to store and transport LOX. Additionally, it eliminates the need for LOX support equipment. The potential for accidents related to LOX and high pressure gases is greatly reduced.

System Components

The basic components of the OBOGS are the concentrator, oxygen monitor, and oxygen breathing regulator. The concentrator produces an oxygen-rich gas by processing engine bleed air through two sieve beds. The oxygen monitor senses the partial pressure of the gas and, if necessary, provides a low-pressure warning to the pilot. The oxygen regulator is a positive pressure regulator.

Table 5-1.—Troubleshooting chart for electrically actuated canopy seal system

Probable cause	Isolation procedure	Remedy
TROUBLE: SEAL WILL NOT INFLATE DURING NORMAL OPERATIONS		
Ruptured seal.	Check the canopy seal by applying an internal air pressure source to the ground test fitting and operating the canopy seal system.	Replace defective seal.
Improperly adjusted or defective canopy latched switch.	Check the adjustment of the canopy latched switch or continuity.	Properly adjust canopy latched switch or replace defective switch.
Defective canopy seal regulator power supply circuit.	Check continuity.	Personnel in the AE rating will repair or replace electrical wire or components as necessary.
Defective canopy seal regulator.	Check continuity.	Replace defective canopy seal regulator.
Canopy seal ground test fitting cap loose or missing.	Check visually.	Tighten or replace the cap.
Canopy seal ground test fitting cap and canopy seal vent fitting reversed.	Check visually.	Reverse fittings.
TROUBLE: SEAL WILL NOT INFLATE DURING GROUND TESTING		
Check valve defective.	Ground test the canopy seal system.	Replace check valve O-rings or replace check valve.
Defective canopy seal regulator.	Check continuity of electrical solenoid. Check canopy seal.	Replace canopy seal regulator.
Ruptured seal.	Check canopy seal.	Replace defective seal.
Defective canopy seal regulator power supply circuit.	Check continuity.	Personnel in the AE rating will repair or replace electrical wire or components as necessary.

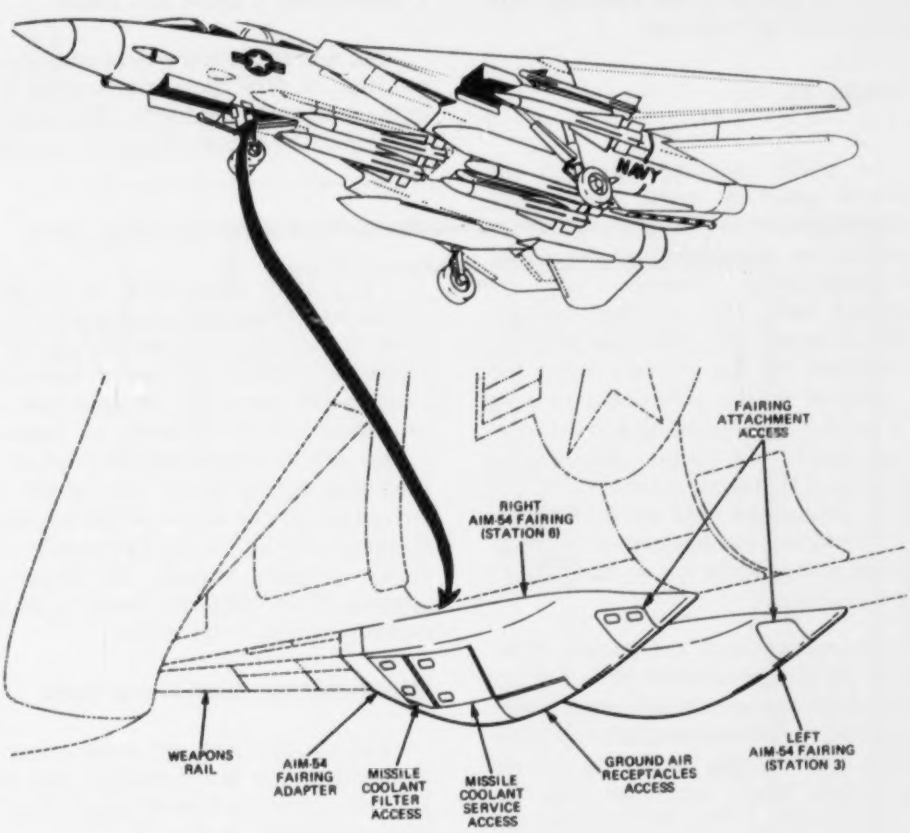

COCKPIT
MASK
RALSA
EMERG OXY
CRU-60/P CONNECTOR
OBOGS BREATHING REGULATOR
OBOGS OXYGEN MONITOR
COCKPIT PLENUM
ENGINE COMPARTMENT
GROUND TEST PORT
BLEED AIR SHUTOFF VALVE
8TH STAGE BLEED AIR
ENGINE
OVERTEMPERATURE WARNING SWITCH
OVERBOARD
COOLING AIR
HEAT EXCHANGER
MAIN WHEEL WELL
AIRFRAME PRESSURE REGULATOR
OVERTEMPERATURE WARNING SWITCH
OBOGS CONCEN-TRATOR
NITROGEN RICH EXHAUST
BREATHING GAS
REAR FUSELAGE EQUIPMENT BAY
OVERBOARD
CONTROL VALVE
MOLECULAR SIEVE BED 2
PURGE ORIFICE
OXYGEN ENRICHED OUTPUT
AIR INLET
MOLECULAR SIEVE BED 1
M1
NITROGEN RICH PURGE-EXHAUST

214.163X

Figure 5-15.—OBOGS schematic.

System Operation

The OBOGS, shown in figure 5-15, receives engine bleed air from the outlet of the air-conditioning heat exchanger. The partially cooled air passes through an air temperature sensor to a pressure reducer assembly. The air is then routed to the concentrator. The concentrator has a rotary valve which alternates the airflow over the molecular sieve beds. The sieve beds adsorb the nitrogen and allow the oxygen and argon to pass through. Two molecular sieve beds are used in the concentrator so that while one bed is adsorbing, the other is desorbing (releasing) nitrogen. This method allows a continuous flow of oxygen to the system. After the concentrator, the oxygen flows


NAVY
FAIRING ATTACHMENT ACCESS
RIGHT AIM-54 FAIRING (STATION 6)
WEAPONS RAIL
AIM-54 FAIRING ADAPTER
MISSILE COOLANT FILTER ACCESS
MISSILE COOLANT SERVICE ACCESS
GROUND AIR RECEPTACLES ACCESS
LEFT AIM-54 FAIRING (STATION 3)

214.164

Figure 5-16.—Missile fairing.

to a plenum assembly which acts as a surge tank and an accumulator. The plenum also functions as a heat exchanger to heat or cool the oxygen to approximately cockpit temperature. Before the oxygen reaches the oxygen regulator, the oxygen performance monitor senses the partial pressure of the gas and, if necessary, provides a signal to the pilot whenever the pressure exceeds prescribed limits. The oxygen then flows through the regulator to the pilot's mask.

MISSILE LIQUID COOLING UTILITY SYSTEM

The liquid cooling system in the F-14 aircraft is used with the radar and missile systems. The cooling system, discussed in this chapter, is used to both heat and cool the Phoenix missile.

SYSTEM DESCRIPTION

The air intercept missile temperature control system governs the correct heating or cooling of the missile. The cooling loop contains a dielectric coolant fluid which is circulated by a motor-driven pump. The fluid is filtered to remove air, moisture, and foreign matter. To cool or heat the fluid, the air-to-coolant heat exchanger uses two types of air: refrigeration system air or 400°F bleed manifold air. The missile temperature control system also uses ground cooling air when ground operation is required. When missiles are loaded on the aircraft, as shown in figure 5-16, two fairings are installed. Both fairings are used to improve the flow of air over the missiles. The starboard fairing contains the missile coolant pump assembly and the air-moisture-contaminant remover. When the aircraft is not equipped with missiles, the fairings are removed.

SYSTEM OPERATION

Setting the liquid cooling switch to the AWG-9/AIM-54 position starts the missile coolant pump motor. The pump circulates 18 gallons of coolant per minute through the missile air-moisture-contaminant remover, heat exchanger, weapon rails, left and right pylons, launchers, and as many as six Phoenix missiles. The heat absorbed by the coolant from the missiles is removed in the air-to-coolant heat exchanger. When the loop is operating in the cooling mode, the missile inlet coolant temperature sensor controls the fluid temperature at 70° ± 3 °F by opening or closing the cold air modulating valve. The valve varies the amount of cold air flowing from the refrigeration system through the missile heat exchanger.

When the temperature of the coolant fluid returning from the missile is below 40° ± 3 °F, as sensed by the missile outlet coolant temperature sensor, the cooling system automatically switches to the warm-up mode. In this mode, the cold air modulating valve closes and the hot air modulating valve opens. This valve varies the amount of hot air from the 400 °F bleed manifold temperature control system used to warm the coolant fluid.

When the heat exchanger outlet fluid temperature reaches 104° ± 4 °F and the missile outlet fluid temperature reaches 85° ± 3 °F, the hot air modulating valve will close. This prevents the cold and hot air modulating valves from being open simultaneously.

The missile supply line sensor, located at the outlet of the heat exchanger, is also used to sense an overtemperature condition. If the coolant temperature exceeds 115° ± 3 °F, the missile condition (MSL COND) advisory indicator light illuminates. The hot or cold air modulating valve will close. If the missile pump pressure drops to 60 ± 5 psi, a pressure switch causes the MSL COND light to illuminate. If pressure downstream of the pump increases to 89 ± 5 psi, the missile bypass valve opens to return the fluid to the pump inlet.

COMPONENT DESCRIPTION

The missile cooling system consists of 11 components. Each of these components is discussed in the following paragraphs. The functional relationship of the components is represented in figure 5-17.

Missile Cold Air Modulating Valve

The cold air modulating valve is mounted on the air-to-coolant heat exchanger. It varies the flow of refrigeration system air to the heat exchanger. The valve has a butterfly, a diaphragm-type pneumatic actuator that is mechanically linked to the butterfly, an electromagnetic torque motor, and butterfly position switches. Electrical signals from the missile controller govern the torque motor, which allows regulated air pressure to be vented. The smaller the amount of air pressure vented, the larger the valve opening. If the electrical power or air pressure is interrupted, the valve closes.

Missile Hot Air Modulating Valve

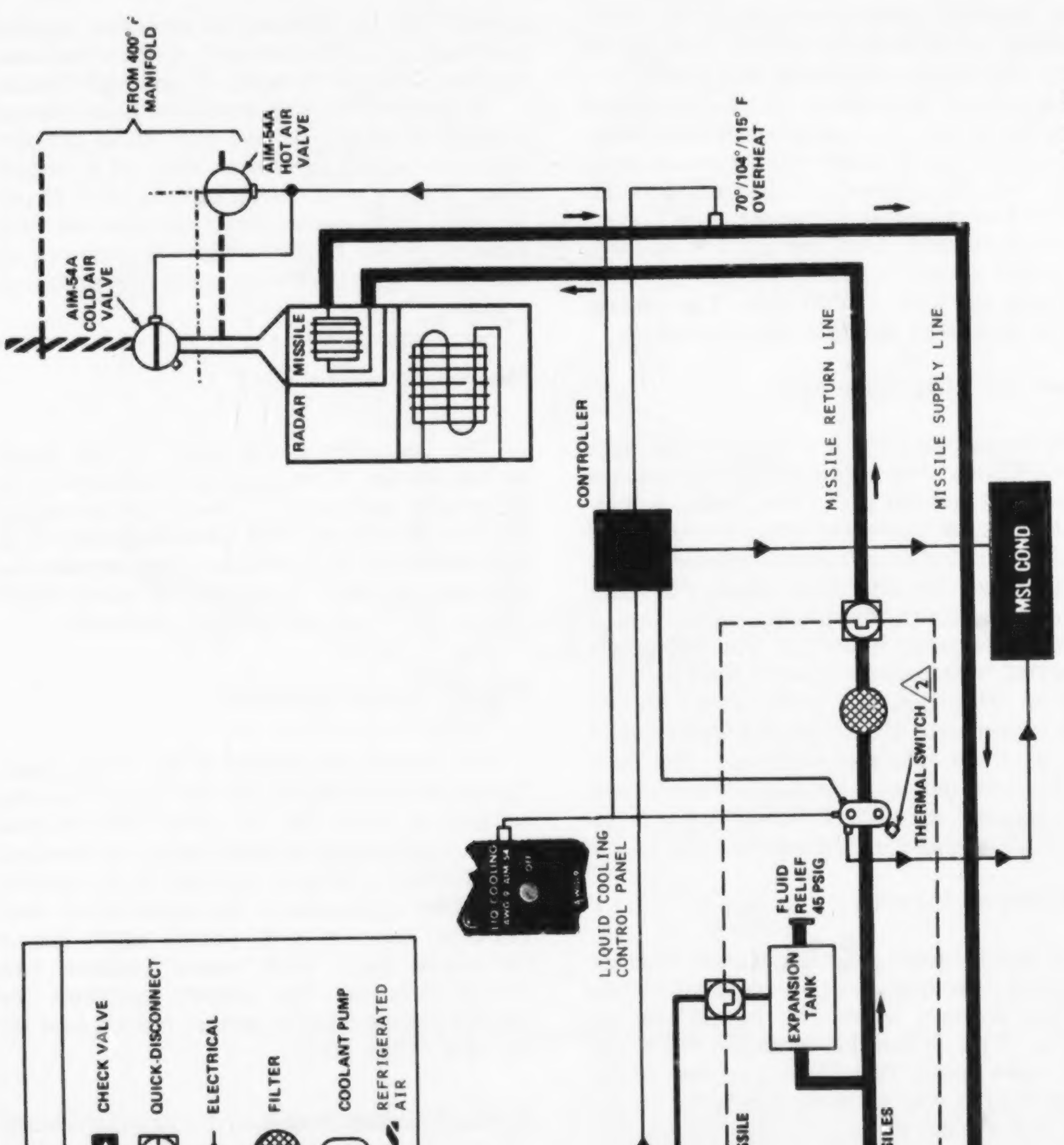
The missile hot air modulating valve is mounted on the air-to-coolant heat exchanger. The valve varies the flow of hot air from the 400 °F bleed manifold temperature control system in response to electrical signals from the controller. The hot air heats the coolant during system warm-up. The operation of the valve is the same as the missile cold air modulating valve.

Missile Air-to-Coolant Heat Exchanger

The heat exchanger consists of two sections: weapons control system (radar) loop, and missile loop. The heat exchanger is similar to an automobile radiator. The coolant flows through the core while air flows around the core. When the radar portion of the heat exchanger is being used, the missile cold and hot air modulating valves are closed to prevent reverse flow through the missile section.

Missile Coolant Pump

The coolant pump is a single-stage, centrifugal pump driven by a low-slip, two-pole induction


LEGEND
LIQUID COOLANT
400° MANIFOLD
CONTROLLED AIR
SERVO AIR
REGULATOR VALVE
MODULATING VALVE
SENSING LINE
CHECK VALVE
QUICK-DISCONNECT
ELECTRICAL
FILTER
COOLANT PUMP
REFRIGERATED AIR
FROM 400° F MANIFOLD
AIM-54A HOT AIR VALVE
AIM-54A COLD AIR VALVE
RADAR
MISSILE
CONTROLLER
70°/104°/115° F OVERHEAT
MISSILE RETURN LINE
MISSILE SUPPLY LINE
MSL COND
THERMAL SWITCH 2
LIQUID COOLING CONTROL PANEL
LIQ COOLING
AWG 9 AIM 54
OFF
AWG 9
FLUID RELIEF 45 PSIG
EXPANSION TANK
PHOENIX MISSILE FAIRING
FROM MISSILES
TO MISSILES
40°/85° F

214.165

Figure 5-17.—Missile cooling system.

motor. When the pump is operating, it circulates 18 gallons of coolant per minute through the system. The pump is lubricated and cooled by a small portion of the coolant, which is circulated through the motor. A pressure switch in the pump outlet opens when the pump output pressure drops to 60 ± 5 psi. The pressure switch causes the MSL COND advisory light to illuminate. Also, a thermal switch will open when 230° ± 5°F is reached. This switch causes the pump to stop and also illuminates the MSL COND light. The coolant pump is located in the right Phoenix fairing.

Coolant Fluid Expansion Tank

The expansion tank is located in the right Phoenix fairing. The tank maintains a constant coolant fluid pressure at the pump inlet, accommodates thermal expansion of the coolant, and provides a coolant reserve for the missile loop in case of leakage. The tank has a bellows, fluid sight and level indicator, fluid relief valve, and a pneumatic pressure indicator. The bellows is pressurized to maintain a positive fluid pressure of 30 to 37 psi at the pump inlet. Should pressurization reach 45 ± 2.3 psi, the fluid pressure relief valve will open and vent fluid. The fluid sight and level indicator displays fluid level and the pneumatic pressure indicator extends to indicate air pressure by temperature degrees.

Missile Bypass Valve

The missile bypass valve is located at fuselage station 372. It is used to bypass the missile when the fluid pressure within the missile reaches 89 +0 to −5 psi. When this condition exists, the bypass valve opens. This allows a portion of the coolant fluid to flow from the supply line to the return line without passing through the missile.

Missile Air-Moisture-Contaminant Remover

The remover is mounted in the right Phoenix fairing. It removes air, moisture, and foreign particles from the coolant, but it does not remove standing water. The remover consists of a cleanable filter element, a replaceable removal cartridge, a fail-safe valve and indicator, a relief valve, and an automatic shutoff valve. If the removal cartridge fails, the fail-safe valve prevents coolant loss by securing the air-water removal overboard port. If this occurs, a yellow indicator button is released to warn of cartridge failure.

If the pressure drop across the filter element exceeds 16 ± 3 psi, the red differential pressure indicator button extends to warn of a clogged filter. If the pressure drop exceeds 21 to 25 psi, the relief valve passes coolant around the filter element. When the filter bowl is removed, an automatic shutoff valve closes to prevent loss of coolant.

Missile Controller

The controller is the brain of the liquid cooling system. It receives electrical input from the sensors and controls component operation. It keeps the hot and cold air modulating valves from opening at the same time. The controller also provides electrical signals to the naval flight officer (NFO) caution advisory indicator.

Coolant Temperature Sensor

Two sensors are located in the cooling loop. The sensors are isolated from the coolant by being installed in wells that are filled with thermal grease. Both sensors are identical in construction, but each has a different purpose in the system. One sensor is mounted in the missile return line. The other sensor is in the missile supply line of the missile loop. Each sensor contains two sensing elements. One element performs the primary sensing function and the other is used for the built in test (BIT).

Fairing Interlock Switch

This switch provides an electrical connection for the missile coolant pump motor and pressure switch circuits. The switch is closed when the right Phoenix fairing is installed.

Liquid Cooling Control Panel

This control panel, shown in figure 5-17, is located on the NFO's left side console. When the

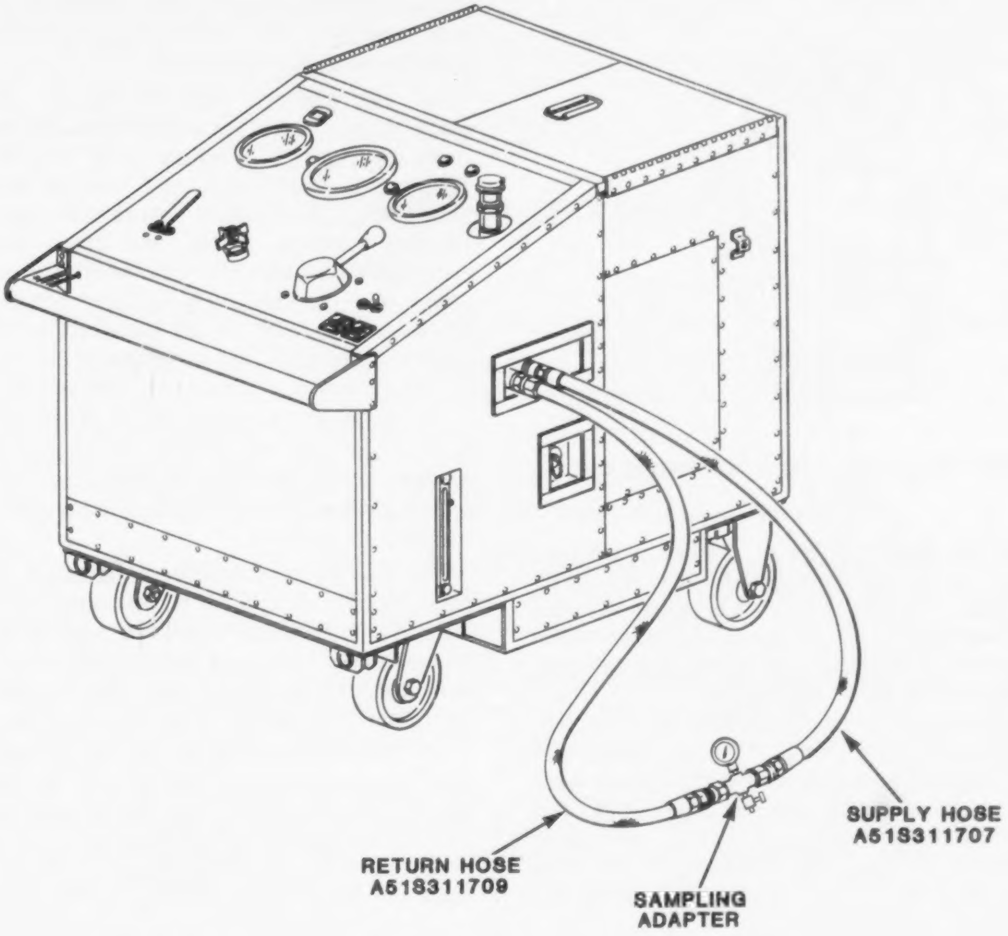


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Figure 5-18.—Liquid coolant service unit.

liquid cooling switch is set to the AWG-9/AIM-54 position, it activates both the radar and missile cooling loops of the system.

MAINTENANCE SAFETY PRECAUTIONS

The Phoenix missile requires a completely contaminant-free cooling system. Keeping the system clean requires the use of toxic fluids that must be used with special care. It is important to handle this system with the same care as you would handle an oxygen system. The following information contains notes of special interest that you should keep in mind when working on this system.

1. If more than 1 gallon of coolant is required to fill the expansion tank, you should flush and refill the system using the liquid coolant service unit (LCSU) shown in figure 5-18. For detailed LCSU operating procedures, you should refer to the applicable maintenance instructions manual.
2. The cooling system should only be serviced with Flo-cool 180, Coolanol 25, or Coolanol 25-R.

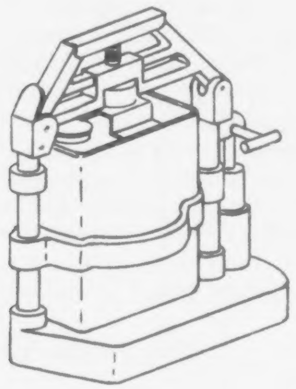

Figure 5-19.—Liquid coolant fluid make-up unit.

If you use another type of coolant, you may damage the missile components. It is a requirement that you wear a respirator while working with these coolants, or work in an area with forced ventilation. Additionally, you must wear chemical splash-proof goggles and gloves.

3. When you use trichlorotrifluoroethane, MIL-C-81302 Type I or II, to clean fittings and hoses, exercise extreme caution. You must wear chemical splash-proof goggles and gloves. The task should be performed in an area with good ventilation. Smoking is prohibited in the area where this chemical is being handled. Keep the trichlorotrifluoroethane from coming in contact with your skin, eyes, and clothes. Do not breathe the vapors as they are toxic.

4. To prevent contamination of the temperature control system and possible damage to its components, absolute cleanliness of your equipment, work area, and coolant must be maintained. You should ensure that dust caps, flushing jumpers, hoses, and bleed lines are thoroughly cleaned with trichlorotrifluoroethane and a lint-free cloth. The cleaned components should be air-dried before installation. Do not allow the cleaning fluid to remain in contact with O-ring seals for any extended period of time.

5. When adding coolant with the fluid make-up unit, shown in figure 5-19, you should add the coolant slowly. Rapid pumping may cause the pressure relief valves on the make-up unit and in the aircraft to open.

6. You should take care in handling coolant near the aircraft because it can cause damage to the paint. In the event of spillage, wipe up the area immediately. Also, you should keep the coolant from coming in contact with the coaxial cable because it will degrade the integrity of the cable.

7. To take a coolant sample, the coolant must have been circulated 5 minutes by the aircraft powered pump. This circulation process ensures that the sample will be representative of coolant in the entire system. The sample should be taken from the AIM-54 supply bleed port.

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NONRESIDENT CAREER COURSE

AVIATION STRUCTURAL MECHANIC E 1&C

NAVEDTRA 10312-D

This self-study course is only one part of the total Navy training program. By its very nature it can take you only part of the way to a training goal. Practical experience, schools, selected reading, and YOUR desire to succeed are also necessary to round out a fully meaningful training program.

Your Nonresident Career Course (NRCC) contains a set of assignments and perforated answer sheets. If an errata sheet comes with the NRCC, make all indicated changes or corrections. Do not change or correct the Rate Training Manual (RTM) or assignments in any other way.

HOW TO COMPLETE THIS COURSE SUCCESSFULLY

You should read the RTM before taking the NRCC. Study the RTM pages given at the beginning of each assignment before trying to answer the questions. Pay attention to tables and illustrations as they contain a lot of information. Making your own drawings can help you understand the subject matter. You should read the learning objectives preceding each set of questions. The learning objectives and questions are based on the subject matter of the RTM. The learning objectives tell you what you should be able to do after studying the RTM. Answering the questions should help you accomplish the objectives.

At this point, you should be ready to answer the questions in the assignment. Read each question carefully. Select the BEST ANSWER for each question, consulting your RTM when necessary. Be sure to select the BEST ANSWER from the subject matter in the RTM. You may discuss difficult points in the course with others. However, the answer you select must be your own. Remove a perforated answer sheet from the back of the NRCC, write in the proper assignment number, and enter your answer for each question.

Your NRCC will be administered by your command or, in the case of small commands, by the Naval Education and Training Program Development Center. No matter who administers your course you can complete it successfully by earning a 3.2 for each assignment. The unit breakdown of the course, if any, is shown later under Naval Reserve Retirement Credit.

WHEN YOUR COURSE IS ADMINISTERED BY LOCAL COMMAND

As soon as you have finished an assignment, submit the completed answer sheet to the officer designated to grade it. The graded answer sheet will not be returned to you.

If you are completing this NRCC to become eligible to take the fleetwide advancement examination, follow a schedule that will enable you to complete all assignments in time. Your schedule should call for the completion of at least one assignment per month.

Although you complete the course successfully, the Naval Education and Training Program Development Center will not issue you a letter of satisfactory completion. Your command will make an entry in your service record, giving you credit for your work.

WHEN YOUR COURSE IS ADMINISTERED BY THE NAVAL EDUCATION AND TRAINING PROGRAM DEVELOPMENT CENTER

After finishing an assignment, go on to the next. Retain each completed answer sheet until you finish all the assignments in a unit (or in the course if it is not divided into units). Using the envelopes provided, mail your completed answer sheets to the Naval Education and Training Program Development Center where they will be graded and the score recorded. Make sure all blanks at the top of the answer sheet are filled in. Unless you furnish all the information required, it will be impossible to give you credit for your work. The graded answer sheets will not be returned.

The Naval Education and Training Program Development Center will issue a letter of satisfactory completion to certify successful completion of the course (or a creditable unit of the course). To receive a course-completion letter, follow the directions given on the course-completion form in the back of this NRCC.

You may keep the RTM and assignments for this course. Return them only in the event you disenroll from the course or otherwise fail to complete the course. Directions for returning the RTM and assignments are given on the course disenrollment-course completion form in the back of this NRCC.

PREPARING FOR YOUR ADVANCEMENT EXAMINATION

The *Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards*, NAVPERS 18068, lists by paygrade the minimum tasks you must be able to perform in your rating. These tasks are called occupational standards. Your examination for advancement is based on these occupational standards. The material used to prepare the questions for your advancement examination is listed in the *Bibliography for Advancement Examination Study*, NAVEDTRA 10052. For your convenience, the occupational standards and the bibliography for your rating are combined in a single booklet for the examinations given each year. These *Occupational Standards and Bibliography* booklets are available from your Educational Services Officer (ESO). Even though you have met the course requirement by successfully completing this NRCC, you should continue to study the RTM as you prepare for the advancement examination. Remember the RTM is one of the sources for advancement examination questions. Because the qualifications for your rating may have changed since your RTM was printed, you should refer to the latest annual edition of the rating *Occupational Standards and Bibliography* booklet.

NAVAL RESERVE RETIREMENT CREDIT

The course is evaluated at 6 Naval Reserve retirement points. Points will be credited upon satisfactory completion of the three assignments. These points are creditable to personnel eligible to receive them under current directives governing retirement of Naval Reserve personnel.

COURSE OBJECTIVE

In completing this NRCC, you will demonstrate a knowledge of the subject matter by correctly answering questions on the following: electrically operated canopy systems, frangible escape systems, cartridges, cartridge-actuated devices, Martin-Baker ejection seat, Stencel ejection seat, ejection seat corrosion control, bleed-air systems, air-conditioning systems, pressuriztion systems, multimeter procedures, deice systems, rain-removal systems, anti-g systems, canopy seal systems, onboard oxygen generating systems, and liquid-cooled utility systems.

While working on this correspondence course, you may refer freely to the text. You may seek advice and instruction from others on problems arising in the course, but the solutions submitted must be the result of your own work and decisions. You are prohibited from referring to or copying the solutions of others, or giving completed solutions to anyone else taking the same course.

Naval courses may include several types of questions—multiple-choice, true-false, matching, etc. The questions are not grouped by type but by subject matter. They are presented in the same general sequence as the textbook material upon which they are based. This presentation is designed to preserve continuity of thought, permitting step-by-step development of ideas. Not all courses use all of the types of questions available. The student can readily identify the type of each question, and the action required, by inspection of the samples given below.

MULTIPLE-CHOICE QUESTIONS

Each question contains several alternatives, one of which provides the best answer to the question. Select the best alternative, and blacken the appropriate box on the answer sheet.

SAMPLE

s-1. Who was the first person appointed Secretary of Defense under the National Security Act of 1947?

1. George Marshall
2. James Forrestal
3. Chester Nimitz
4. William Halsey

Indicate in this way on the answer sheet:

	1 T	2 F	3	4	
s-1	☐	■	☐	☐	- - -

TRUE-FALSE QUESTIONS

Mark each statement true or false as indicated below. If any part of the statement is false the statement is to be considered false. Make the decision, and blacken the appropriate box on the answer sheet.

SAMPLE

s-2. All naval officers are authorized to correspond officially with any systems command of the Department of the Navy without their respective commanding officer's endorsement.

1. True
2. False

Indicate in this way on the answer sheet:

	1 T	2 F	3	4	
s-2	☐	■	☐	☐	- - -

MATCHING QUESTIONS

Each set of questions consists of two columns, each listing words, phrases or sentences. The task is to select the item in column B which is the best match for the item in column A that is being considered. Items in column B may be used once, more than once, or not at all. Specific instructions are given with each set of questions. Select the numbers identifying the answers and blacken the appropriate boxes on the answer sheet.

SAMPLE

In questions s-3 through s-6, match the name of the shipboard officer in column A by selecting from column B the name of the department in which the officer functions. Some responses may be used once, more than once, or not at all.

A. OFFICER

s-3. Damage Control Assistant

s-4. CIC Officer

s-5. Disbursing Officer

s-6. Communications Officer

B. DEPARTMENT

1. Operations Department
2. Engineering Department
3. Supply Department

Indicate in this way on the answer sheet:

	1 T	2 F	3	4	
s-3	☐	■	☐	☐	- - -
s-4	■	☐	☐	☐	- - -
s-5	☐	☐	■	☐	- - -
s-6	■	☐	☐	☐	- - -

Assignment 1

Textbook Assignment: "Emergency Egress and Canopy Systems." Pages 1-1 through 1-30.

In this course you will demonstrate that learning has taken place by correctly answering training items. The mere physical act of indicating a choice on an answer sheet is not in itself important; it is the mental achievement, in whatever form it may take, prior to the physical act that is important and toward which course learning objectives are directed. The selection of the correct choice for a course training item indicates that you have fulfilled, at least in part, the stated objective(s).

The accomplishment of certain objectives, for example, a physical act such as drafting a memo, cannot readily be determined by means of objective type course items; however, you can demonstrate by means of answers to training items that you have acquired the requisite knowledge to perform the physical act. The accomplishment of certain other learning objectives, for example, the mental acts of comparing, recognizing, evaluating, choosing, selecting, etc., may be readily demonstrated in a course by indicating the correct answers to training items.

The comprehensive objective for this course has already been given. It states the purpose of the course in terms of what you will be able to do as you complete the course.

The detailed objectives in each assignment state what you should accomplish as you progress through the course. They may appear singly or in clusters of closely related objectives, as appropriate; they are followed by items which will enable you to indicate your accomplishment.

All objectives in this course are learning objectives and items are teaching items. They point out important things, they assist in learning, and they should enable you to do a better job for the Navy.

This self-study course is only one part of the total Navy training program; by its very nature it can take you only part of the way to a training goal. Practical experience, schools, selected reading, and the desire to accomplish are also necessary to round out a fully meaningful training program.

Learning Objective: Recognize F/A-18A canopy components and their functions.

1-1. Which of the following publications discusses training and leadership responsibilities?

1. NAVPERS 18068
2. NAVEDTRA 10343
3. NAVEDTRA 10311
4. NAVPERS 2002

1-2. The F/A-18A canopy is normally operated in which of the following modes?

1. Pneumatic
2. Hydraulic
3. Electrical
4. Manual

1-3. Under normal conditions, the canopy is controlled by which of the following devices?

1. Internal canopy control switch
2. External canopy control switch
3. Both 1 and 2 above
4. Manual canopy control handle

1-4. When the canopy actuation control system has failed, what method will be used to open and close the canopy?

1. Manual back-up mode
2. External electrical power
3. Internal electrical power
4. Utility battery power

1-5. Which of the following components is mounted on the canopy?

1. Canopy unlatch thruster
2. Canopy contactor
3. Canopy actuator
4. Canopy pressure seal

1-6. The canopy actuator, used to open and close the canopy, is protected by a thermal device that senses an overheat condition.

1. True
2. False

1-7. What total number of manual methods are available to open and close the canopy?

1. One
2. Two
3. Three
4. Four

1-8. What total number of canopy control switches are provided for normal electrical operation of the canopy?

1. One
2. Two
3. Three
4. Four

1-9. What canopy contactor supplies power to the close windings of the canopy actuator motor?

1. Up
2. Down
3. Open
4. Close

1-10. In what canopy latch retainer is the canopy position switch mounted?

1. Number 1
2. Number 2
3. Number 3
4. Number 4

1-11. What switch(es) must be depressed to extinguish the master caution light?

1. Canopy position switch
2. Canopy locked switch
3. Both 1 and 2 above
4. Canopy caution switch

1-12. Both canopy switch plungers must be depressed within what maximum number of seconds?

1. 5
2. 10
3. 15
4. 20

1-13. What components provide vertical restraint when the canopy is closed?

1. Index pins
2. Cam rollers
3. Latch retainers
4. Connecting links

1-14. What component provides longitudinal restraint to the canopy?

1. Index pin
2. Cam roller
3. Latch retainer
4. Connecting link

1-15. If you use the internal manual canopy handle, what maximum number of turns may be required to close the canopy?

1. 70±1
2. 75±1
3. 80±1
4. 85±1

1-16. What component transfers the mechanical motion of the manual drive unit to the canopy actuator?

1. Handle assembly
2. Actuator arm
3. Shaft assembly
4. Torque limiter

1-17. What maximum number of turns may be required to externally operate the canopy actuator manual drive unit?

1. 5±1
2. 15±1
3. 25±1
4. 35±1

1-18. What component prevents damage to the actuator if excessive force is applied in the manual back-up control mode?

1. Handle assembly
2. Actuator arm
3. Shaft assembly
4. Torque limiter

1-19. Which of the following handles will cause the canopy to be jettisoned?

1. Internal jettison
2. External jettison
3. Ejection control
4. Each of the above

1-20. What device(s) prevents the backflow of an SMDC detonation from reaching the seat components?

1. Emergency escape disconnect
2. One-way transfer valve
3. SMDC initiator
4. Both 2 and 3 above

1-21. What component provides the ballistic gas that fires the canopy jettison rocket motor?

1. Canopy jettison SMDC initiator
2. Emergency escape disconnect
3. Canopy unlatch thruster
4. Canopy jettison FCDC initiator

1-22. What component provides the vertical thrust needed to separate the canopy from the aircraft?

1. Canopy actuator
2. Rocket motor
3. Unlatch thruster
4. SMDC initiator

1-23. Which of the following devices is used to protect SMDCs?

1. Metallic sheath
2. Braid overwrap
3. Stainless steel tubing
4. Aluminum tubing

1-24. A frangible escape system is used to jettison the canopy on the S-3A aircraft.

1. True
2. False

1-25. The S-3A canopy glass is removed during ejection by what device(s)?

1. Glass cutters
2. Glass crashers
3. Breaker plates
4. Both 2 and 3 above

1-26. What is the approximate length of the external jettison initiator cable?

1. 6 feet
2. 8 feet
3. 10 feet
4. 12 feet

1-27. Which of the following parts will be blown away from the aircraft when either of the external handles is pulled?

1. Hatches
2. Fillets
3. Supports
4. All of the above

1-28. What total number of internal initiators are in the canopy and hatch jettison system?

1. Five
2. Two
3. Three
4. Four

1-29. What device prevents the internal jettison handle from being squeezed and pulled?

1. Shear pin
2. Safety pin
3. Shear wire

1-30. Which, if any, of the following actions will initiate the SMDC when the safety pins are installed?

1. Drilling
2. Filing
3. Hammering
4. None of the above

1-31. What is the total number of SMDC initiator handles in the S-3A aircraft?

1. Five
2. Six
3. Three
4. Four

1-32. Which of the following internal initiator handles will actuate all canopy and hatch SMDC assemblies?

1. Pilot's
2. TACCO's
3. SENSO's
4. Each of the above

Learning Objective: Recognize ordnance publications.

A. Description, Preparation for Use, and Handling Instructions, Aircrew Escape Propulsion System (AEPS) Devices

B. General Use Cartridges and Cartridge Actuated Devices for Aircraft and Associated Equipment

C. Ammunition Afloat

D. Ammunition and Explosives Ashore

Figure 1A

IN ANSWERING QUESTIONS 1-33 THROUGH 1-36, SELECT THE PUBLICATION NAME FROM FIGURE 1A WHICH RELATES TO THE PUBLICATION NUMBER USED AS THE QUESTION.

1-33. NAVAIR 11-85-1.

1. A
2. B
3. C
4. D

1-34. OP 4.

1. A
2. B
3. C
4. D

1-35. OP 5.

1. A
2. B
3. C
4. D

1-36. NAVAIR 11-100-1.

1. A
2. B
3. C
4. D

Learning Objective: Recognize the source of information for CADs. Recognize administrative procedures related to CADs.

1-37. The specific period of time that a CAD is allowed to be used is known as

1. shelf life
2. service life
3. installed life
4. removed life

1-38. What date must be checked prior to installing a CAD into any system?

1. Open
2. Expiration
3. Installed
4. Manufacture

1-39. To determine the service-life expiration date of a CAD, what date(s) must be computed?

1. Aircraft life
2. Shelf life
3. Installed life
4. Both 2 and 3 above

1-40. What is the month of manufacture

1. September
2. October
3. November
4. December

1-41. If the date of manufacture of CAD is 0981 and the shelf life 6 years, what is the shelf-life expiration date?

1. 0985
2. 0986
3. 0987
4. 0988

1-42. To which of the following manuals should you refer to determine the installed-life expiration date of a CAD?

1. NAVAIR 11-100-1
2. NAVAIR 11-85-1
3. OP 4
4. OP 5

1-43. To determine the installed-life expiration date, the installed-life date is added to the date the container was

1. opened
2. received from supply
3. received from the manufacturer
4. sealed by the manufacturer

1-44. If the installed life is 66 months, what is the installed-life expiration date of a CAD whose container was opened during 1183?

1. 0588
2. 0688
3. 0589
4. 0689

1-45. After the shelf life and installed life dates have been computed, the earlier date will be used for the CAD service-life expiration date.

1. True
2. False

1-46. A hermetically sealed container was opened on 15 March. Which of the following dates is used to compute expiration date?

1. 1 January
2. 1 March
3. 15 March
4. 31 March

1-47. Scribing is an approved method for marking expiration dates on CADs.

1. True
2. False

1-48. Which of the following dates must be marked on a CAD that is being installed in an aircraft?

1. Installed
2. Shelf life
3. Container opened
4. Installed-life

1-49. A logbook entry for a CAD must be made when which of following events occurs?

1. Actuation
2. Replacement
3. Reinstallation
4. Refurbishment

1-50. A contingency service-life extension for a CAD granted by the commanding officer may not exceed what maximum number of days?

1. 15
2. 30
3. 45
4. 60

1-51. For an additional service-life extension beyond the contingency extension, a message reply will be received from which of the following activities?

1. NAVORDSTA
2. NAVAIRLANT
3. NAVAIRSYSCOM
4. NAVORDSYSCOM

1-52. A change to NAVAIR 11-100-1 may change the permanent service life of CADs. Which of the following methods is used to change NAVAIR 11-100-1?

1. Rapid action change
2. Interim rapid action change
3. Formal change
4. All of the above

Learning Objective: Recognize maintenance procedures used with CADs.

1-53. The service life of wire-braid, teflon-lined hoses is the same as the

1. initiator to which it is attached
2. aircraft in which it is installed
3. CAD to which it leads
4. rocket motor to which it leads

1-54. When should the hoses in an escape system be inspected?

1. At every phased inspection
2. Upon removal of the seat
3. After the hoses are disconnected
4. All of the above

1-55. For safety reasons, which of the following devices will be installed in CADs when they are removed from the aircraft?

1. Caps
2. Plugs
3. Safety pins
4. All of the above

A. 0.10 inch
B. 0.25 inch
C. 0.75 inch
D. 1.00 inch

Figure 1B

IN ANSWERING QUESTIONS 1-56 THROUGH 1-60, SELECT THE CLEARANCE FROM FIGURE 1B WHICH SHOULD BE USED FOR THE STRUCTURAL DESCRIPTION USED AS THE QUESTION.

1-56. A supported section of SMDC and the adjacent structure.

1. A
2. B
3. C
4. D

1-57. Two parallel SMDCs.

1. A
2. B
3. C
4. D

1-58. Straight, unsupported sections of SMDC and the adjacent structure.

1. A
2. B
3. C
4. D

1-59. Unsupported sections of SMDC and any operating mechanism.

1. A
2. B
3. C
4. D

1-60. A supported section of SMDC and an electrical wire bundle.

1. A
2. B
3. C
4. D

1-61. When using the detonating cord inspection gage set to check the booster tip, what action, if any, should you take if the bar does not touch both sides of the gage?

1. Replace the tip
2. File the tip
3. Replace the booster
4. None

1-62. What manual provides the guidelines for an ordnance certification program?

1. OPNAVINST 8023.2
2. OPNAVINST 8024.2
3. OPNAVINST 8024.3
4. OPNAVINST 8024.9

1-63. When using one CAD from a two-CAD set, what information should you mark on the unused CAD?

1. Shelf life
2. Expiration date
3. Container open date
4. Both 2 and 3 above

1-64. Which of the following actions causes CADs to stick?

1. Over-torqueing during installation
2. Using incorrect tools
3. Using incorrect lubricants
4. All of the above

Assignment 2

Textbook Assignment: "Martin-Baker SJU-5/A and Stencel SJU-8A Ejection Seats
Pages 2-1 through 3-34.

Learning Objective: Identify components of the SJU-5/A ejection seat.

2-1. What ejection seat is used in the F/A-18 aircraft?

1. GRU-7
2. H-7
3. SJU-5/A
4. SJU-7/A

2-2. When the ejection seat is installed in the aircraft, what component locks it to the catapult?

1. Time-release mechanism
2. Top latch mechanism
3. Left main beam
4. Right main beam

2-3. What components absorb the inertia forces encountered during barrel separation?

1. Pressure rings
2. Guide bushings
3. Piston rings
4. Expander bushings

2-4. What component locks the guide bushing to the outer barrel?

1. Retaining pin
2. Dowel screw
3. Locking plunger
4. Guide bushing rivet

2-5. The seat height actuator rod is attached to what component?

1. Lower crossmember
2. Center crossmember
3. Upper sliding runner
4. Lower sliding runner

2-6. What component holds the moveable jaw of the scissor mechanism in the closed position?

1. Trombone fitting
2. Drogue gun
3. Rocket motor
4. Time-release mechanism

2-7. By what method is the primary cartridge of the drogue gun fired?

1. Electrical
2. Mechanical
3. Pneumatic
4. Ballistic

2-8. The parachute container houses which of the following parachutes?

1. Controller drogue
2. Main drogue
3. Personnel
4. All of the above

2-9. What handle is the only means by which ejection can be initiated?

1. Safe/arm
2. Face curtain
3. Ejection control
4. Manual override

2-10. What handle is located on the left side of the seat bucket?

1. Safe/arm
2. Ejection control
3. Manual override
4. Shoulder harness control

2-11. What component prevents full upward movement of the manual override handle?

1. Pin puller
2. Shear rivet
3. Safety pin
4. Bell crank assembly

2-12. During the ejection sequence, gas pressure from what cartridge retracts the pin?

1. Right seat initiator
2. Left seat initiator
3. Manual override initiator
4. Time-release initiator

Learning Objective: Identify operational features of the SJU-5/A ejection seat.

2-13. What force actuates the firing pin in the catapult firing mechanism?

1. Ballistic gas
2. Sear removal
3. Electrical current
4. Pneumatic pressure

2-14. What barrel(s) of the catapult will remain with the seat during ejection?

1. Inner
2. Intermediate
3. Outer
4. Both 2 and 3 above

2-15. If the drogue gun primary cartridge fails, what component(s) will fire the secondary cartridge?

1. Rocket motor initiator
2. Time-release mechanism
3. Manual override initiator
4. Both 2 and 3 above

2-16. What force is used to fire the inertia reel cartridge during the ejection sequence?

1. Sear withdrawal
2. Electrical current
3. Gas pressure
4. Heat

2-17. Gas pressure from the TRM travels through what fitting to fire the cartridge in the manual override initiator?

1. Quick-disconnect
2. Trombone
3. Delay
4. Venturi

2-18. When the safe/arm handle is in the safe position, the pilot sees the handle as what color?

1. Yellow
2. Black
3. White
4. Red

2-19. What initiator provides the gas pressure required to activate the IFF?

1. Right seat initiator
2. SMDC initiator
3. Left seat initiator
4. 0.3-second delay initiator

2-20. What initiator actuates the pin puller?

1. Right seat initiator
2. SMDC initiator
3. Left seat initiator
4. 0.3-second delay initiator

2-21. Forward movement of the leg restraints is prevented by what component?

1. Seat bucket
2. Deck mounts
3. Locking lugs
4. Snubbing unit

2-22. At what maximum altitude will the 1.5-second timer in the TRM start to operate?

1. 7,500 feet
2. 8,000 feet
3. 8,500 feet
4. 9,000 feet

Learning Objective: Recognize maintenance test procedures and test indications.

2-23. During the time delay test of the drogue gun, the firing link is pulled from the drogue gun in 0.7 seconds. What action, if any, should be taken?

1. Lubricate the firing link
2. Repeat the test
3. Replace the drogue gun
4. None

2-24. Before you perform checks on the time-release mechanism, which of the following actions should you take?

1. Disarm the TRM
2. Remove the TRM from the seat
3. Inspect the TRM for damage
4. All of the above

2-25. To obtain satisfactory results in the time delay check-out of the time-release mechanism, the firing link must be pulled from the time-release g-sensing mechanism within what maximum number of seconds?

1. 1.5±0.1
2. 1.7±0.1
3. 1.8±0.1
4. 1.8±0.2

2-26. To do a barostat check-out, the test box altimeter must be set to what prescribed millibar value?

1. 1000
2. 1013
3. 1026
4. 1039

Learning Objective: Select characteristics and maintenance procedures related to corrosion.

2-27. If some light corrosion or discoloration is found on a cadmium-plated part, what action, if any, should be taken?

1. Replace the component
2. Remove the corrosion
3. Repaint the component
4. None

2-28. A cadmium-plated part with which of the following corrosion colors should be replaced?

1. White
2. Gray
3. Black
4. Red

Learning Objective: Identify operational features of the SJU-8/A ejection seat.

2-29. Which of the following companies manufactures the SJU-8/A ejection seat?

1. ESCAPAC
2. Stencel
3. Martin-Baker
4. North American

2-30. The SJU-8/A seat provides escape capabilities at which of the following parameters?

1. All altitudes and airspeeds
2. Zero altitude and zero airspeed
3. Maximum airspeeds and altitudes of 600 knots and 50,000 feet
4. Both 2 and 3 above

2-31. What total number of operating modes are incorporated in the SJU-8/A ejection seat?

1. One
2. Two
3. Three
4. Four

2-32. What is the total number of ejection control handles incorporated in the SJU-8/A ejection seat?

1. One
2. Two
3. Three
4. Four

2-33. The catapult cartridge is fired by gas pressure from the

1. inner trombone
2. multi-time delay
3. low-speed selector valve
4. left and right ejection initiators

2-34. What initiator supplies gas pressure to the inertial reel gas-generating initiator?

1. 3.0-second time-delay initiator
2. Left M99 ejection initiator
3. Right M99 ejection initiator
4. Seat and man separation initiator

2-35. Gas pressure is applied to the drogue gun pistons after approximately how many inches of seat travel?

1. 8
2. 12
3. 16
4. 20

Learning Objective: Identify the characteristics of the different modes of operation.

IN ITEMS 2-36 THROUGH 2-39, SELECT FROM COLUMN B THE AIRSPEED AND ALTITUDE INFORMATION THAT APPLIES TO THE MODE IN COLUMN A.

	A. Modes		B. Airspeed and Altitudes
2-36.	Mode 1	1.	Altitude above 14,000 feet
2-37.	Mode 2	2.	Airspeed above 225 knots and altitude below 7,000 feet
2-38.	Mode 3	3.	Altitude between 7,000 and 14,000 feet
2-39.	Mode 4	4.	Airspeed below 225 knots and altitude below 7,000 feet

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2-40. The 0.1-second time delay receives gas pressure from the

1. gas-generating initiator
2. left-hand inner trombone
3. right-hand outer trombone
4. low-speed selector valve

2-41. Under mode 1 conditions, what initiator arms the 14,000-foot aneroid initiator?

1. 0.1-second delay
2. 1.3-second delay
3. 3.0-second delay
4. Left-hand M99 ejection

2-42. Under mode 2 conditions, the output of the 0.1-second delay initiation is blocked by what component?

1. Pin puller
2. Guillotine
3. Drogue release
4. Low-speed selector valve

2-43. What mode(s) would operate as a backup in the event of mode 2 failure?

1. Mode 1 only
2. Mode 3 only
3. Mode 4
4. Modes 1 and 3

2-44. What is the purpose of the 3.0-second time-delay initiator?

1. To arm the 7,000-foot aneroid in mode 2
2. To arm the 14,000-foot aneroid in mode 3
3. To fire the guillotine mechanism
4. To position the low-speed selector valve

Learning Objective: Identify the components and functions of the SJU-8/A subsystems.

2-45. The safe and arm control handle safeties what initiator(s)?

1. Left-hand M99 ejection initiator
2. Right-hand M99 ejection initiator
3. Seat and man separation initiator
4. All of the above

2-46. The output gas pressure from the two M99 ejection initiators is routed to igniters contained in the

1. word motor
2. drogue container
3. catapult cartridge
4. seat back rocket

2-47. Which of the following statements describes the catapult tube assemblies?

1. They provide support for the seat bucket
2. They house the catapult lock and unlock mechanism
3. They provide support for the headrest and personnel parachute
4. All of the above

2-48. The catapult lock mechanism consists of a locking piston and

1. top latch mechanism
2. two retainer rings
3. three guide bushings
4. six locking balls

2-49. The outer trombone assemblies route ballistic gas from the two M99 ejection initiators to the catapult cartridge igniters.

1. True
2. False

2-50. What is the approximate burn time of the seat back rockets?

1. .15 second
2. .25 second
3. .35 second
4. .45 second

2-51. Actuation of what component allows the main parachute canopy assembly to deploy?

1. Word bridle
2. Drogue bridle
3. Parachute container opener
4. Word motor

2-52. What total number of slugs are contained in the spreader gun assembly?

1. 10
2. 14
3. 18
4. 22

2-53. Rotation of the seat pan release rod fires what initiator?

1. Left M99 ejection initiator
2. Multiple time-delay initiator
3. 3-second time-delay initiator
4. Seat and man separation initiator

2-54. Gas pressure from the seat and man separation initiator is transmitted to which of the

1. Inertia reel strap guillotine
2. Drogue release assembly
3. Parachute container opener
4. All of the above

2-55. When the emergency release handle is pulled, which of the following actions take place?

1. The seat release shaft rotates
2. The harness release actuator retracts
3. The firing control disconnect fitting unseats
4. The time-release mechanism arms

2-56. A full emergency oxygen bottle contains a total of how many cubic inches of oxygen?

1. 30
2. 40
3. 50
4. 60

2-57. The emergency oxygen supply lanyard is attached to the bottom of the seat pan and the

1. cockpit deck
2. safe and arm control handle
3. catapult cartridge manifold
4. seat release shaft

2-58. A properly serviced emergency oxygen system should have what prescribed pressure when the bottle is full?

1. 1200 psi
2. 1500 psi
3. 1800 psi
4. 2100 psi

2-59. Automatic actuation of the emergency oxygen supply also provides automatic actuation of the emergency locator beacon.

1. True
2. False

Learning Objective: Recognize SJU-8/A maintenance and safety procedures.

2-60. When performing the safe and arm control assembly check-out, what should be the maximum amount of force required to move the handle to the full up position?

1. 5 lbs
2. 10 lbs
3. 15 lbs
4. 20 lbs

2-61. What is the name of the component that blocks the movement of the initiation rotors?

1. T-bar
2. Interlock block
3. Arming key
4. Trip rod

2-62. During the emergency release handle check, the handle should move up with a maximum force of

1. 20 pounds
2. 30 pounds
3. 40 pounds
4. 50 pounds

2-63. What devices are installed in the separation lanyard retainer assemblies to hold the seat release lanyard bell cranks in place?

1. Trip rods
2. Shear pins
3. Cotter pins
4. Setscrews

2-64. The initial break out force for assembly check should be between

1. 5 and 15 pounds
2. 15 and 25 pounds
3. 25 and 35 pounds
4. 35 and 45 pounds

2-65. When performing the inertia reel check, the force required to extend the risers should be between

1. 5 and 15 pounds
2. 15 and 25 pounds
3. 25 and 35 pounds
4. 35 and 45 pounds

2-66. To prevent heat damage to the height adjustment actuator motor, what are the operating time limits that must be observed?

1. 15 seconds on and 30 seconds off
2. 30 seconds on and 1 minute off
3. 30 seconds on and 45 seconds off
4. 1 minute on and 1 minute off

2-67. What color flags are used on ejection seat ground safety pins?

1. Red
2. Orange
3. Yellow
4. Black and white

Learning Objective: Identify corrosion control procedures.

2-68. According to the NA 01-1A-509, ejection seats should be inspected for corrosion control at what minimum interval while at sea?

1. Every day
2. Every other day
3. Every 7 days
4. Every 14 days

2-69. VV-L-800 lubricating oil should be applied to all points that slide and used as a corrosion preventive for all bright metal parts.

1. True
2. False

2-70. During emergency cleaning of the ejection seat, what should you use to rinse the seat?

1. Lubricating oil
2. Fresh water
3. Safety solvent
4. Water emulsion cleaner

Assignment 3

Textbook Assignment: "Utility, Air-conditioning, and Pressurization System." Pages 4-1 through 5-24.

Learning Objective: Recognize components and operational features of the bleed-air system.

3-1. What stage of the compressor is the primary source of bleed air for operation of the ECS?

1. 10th
2. 12th
3. 14th
4. 16th

3-2. What do the lights for the bleed-air shutoff valves indicate?

1. Switch position
2. Valve position
3. Both 1 and 2 above
4. High temperature

3-3. In the event of a rupture in the left or right manifold, what valve will prevent overbleeding of the engines?

1. Bleed-air shutoff
2. 10th-stage check
3. High-stage check
4. Crossover duct isolation check

3-4. When operating the deicing system with one engine secured, what valve must be open to allow bleed air to both sides of the aircraft?

1. Bleed-air shutoff
2. Bleed-air flow control and shutoff
3. Engine bleed-air bypass and shutoff
4. Crossover duct isolation check

3-5. Which of the following methods is used to (a) control and (b) actuate the bleed-air flow control and shutoff valve?

1. (a) Electric (b) pneumatic
2. (a) Electric (b) electric
3. (a) Pneumatic (b) electric
4. (a) Pneumatic (b) pneumatic

3-6. What air supply source(s) could be used for engine starting and ground operation of the air-conditioning system?

1. Ram air
2. Ground start air
3. APU air
4. Both 2 and 3 above

3-7. Which of the following conditions will cause the bleed-air shutoff valve to close?

1. Overtemperature
2. Overpressure
3. Loss of electrical power
4. All of the above

Learning Objective: Recognize components and operational features of the air-conditioning system.

3-8. What valve will open because of a sensed pressure drop through the ice screen?

1. Bleed-air shutoff
2. Bleed-air flow control and shutoff
3. Engine bleed-air bypass and shutoff
4. Nonice and low-limit control

3-9. What is the total number of basic components in the refrigeration subsystem?

1. 7
2. 8
3. 9
4. 10

3-10. What component, if any, is used to check the oil level in the cooling turbine?

1. Dip stick
2. Pressure gage
3. Sight gage
4. None

3-11. Which of the following conditions will cause the temperature indicator probe in the fan inlet to trip?

1. Obstructions of the ram-air inlet duct
2. Collapse of the ram-air inlet duct
3. Temperature above 440°F
4. All of the above

3-12. What component allows air to pass through the water separator if ice has accumulated in the coalescer bag?

1. Water separator ice screen
2. Coalescer cone
3. Swirl vanes
4. Water separator bypass valve

3-13. What name is given to the air used to cool the sonobuoy and weapons bays?

1. Refrigerated
2. Partially cooled
3. Cabin exhaust
4. Ram

3-14. What component prevents flooding the cabin with ram air when the aircraft is flying at high speeds?

1. Outflow valve
2. Cabin pressure regulator
3. Cabin air temperature control
4. Ram-air shutoff valve

3-15. When the air-conditioning switch is OFF, the AUX vent switch is ON, and the ram-air pressure does not meet cabin exhaust fan requirements, what valve will open?

1. Ram-air shutoff
2. Water separator bypass
3. Cabin outflow
4. Negative pressure relief

3-16. The torque motor in the cabin temperature control modulating valve converts electrical signals to what type signals?

1. Pneumatic
2. Mechanical
3. Magnetic
4. Hydraulic

3-17. What component provides the controlling signal for the cabin temperature control valve?

1. Cabin air thermistors
2. Cabin air sensor
3. Cabin air temperature control
4. Cabin air high-temperature thermostat

3-18. The opening of the cabin air high-temperature limit thermostat internal valve causes what valve(s) to close?

1. Cabin temperature control valve
2. Nonice and low-limit control valve
3. Both 1 and 2 above
4. Bleed-air flow control and shutoff valve

3-19. The cabin temperature control sensor is designed to control the cabin temperature within what number of degrees of the selected temperature?

1. ± 3
2. ± 7
3. ±10
4. ±11

3-20. In the ram-air augmentation mode, the ram-air shutoff valve regulates downstream pressure to what fixed differential above cabin pressure?

1. 7.5±2
2. 5.5±1
3. 3.0±.5
4. 4.0±1

3-21. During manual operation, what switch is used to position the ram-air shutoff valve?

1. Cabin pressurization
2. Air-conditioning
3. Auxiliary vent
4. Temperature select

3-22. When the air conditioning automatically shuts down and the ram-air shutoff valve is fully open, what action, if any, must be taken to restore normal operation?

1. Secure the AUX VENT switch
2. Turn the air-conditioning switch to OFF and then to ON
3. Turn the air-conditioning switch to OFF, then to RESET, and then to ON
4. None

Learning Objective: Recognize components and operational features of the pressurization system.

3-23. What is the total number of cabin pressurization modes of operation provided by the pressure regulator control?

1. Five
2. Two
3. Three
4. Four

3-24. When the aircraft is flying at altitudes in excess of 24,000 feet, what is the prescribed cabin-to-ambient differential pressure?

1. 5 psi
2. 5.7±0.1 psi
3. 6 psi
4. 6.7±0.1 psi

3-25. What component maintains air pressure at a constant 12 psi during rate valve increase operations?

1. Rate selector valve
2. Rate control valve
3. Control pressure regulator
4. Spring-loaded restrictor

3-26. The flow meter tube is etched with a special scale to facilitate reading pressure-corrected flow in what range of pounds per square inch?

1. 0 to 14.7
2. 0 to 14.5
3. 0 to 12.5
4. 0 to 12.4

3-27. The leakage test is started with the rate control valve in the start position and the rate selector valve in the closed position.

1. True
2. False

Learning Objective: Recognize operating procedures for a multimeter.

3-28. Which of the following instruments is used to measure direct current, alternating current, and resistance?

1. Direct current meter
2. Alternating current meter
3. Ohmmeter
4. Multimeter

3-29. When measuring resistance, in what position should you place the -dc/+dc/ac switch?

1. -dc
2. +dc
3. +ac
4. Resistance

3-30. When the multimeter is not in use, in what position should you place the range function switch?

1. Lowest resistance setting
2. Highest resistance setting
3. Lowest voltage setting
4. Highest voltage setting

3-31. Which of the following actions should be taken to read the resistance of a component after setting the meter to zero?

1. Keep the meter in the same position
2. Insert the black test lead in the (+) jack
3. Keep the reading on the left side of the second scale
4. All of the above

Learning Objective: Identify deicing system components, functions and operating features.

3-32. Which of the following systems is used to prevent ice from forming on an aircraft?

1. Anti-ice
2. Deice
3. Rain-removal
4. Defrost

3-33. The P-3 aircraft uses what source of heat for its deicing system

1. Electrical energy
2. Bleed air
3. Hydraulic pumps
4. Solar energy

3-34. The total number of bleed-air shutoff valves on the P-3 aircraft is

1. five
2. six
3. three
4. four

3-35. By what method are the deicing system modulating valves controlled?

1. Pneumatic
2. Hydraulic
3. Electric
4. Thermostatic

3-36. What component causes the modulating valve to close when the pressure is reduced on the modulating valve diaphragm?

1. Spring
2. Solenoid
3. Sensor
4. Spoon

3-37. Which of the following conditions will cause high temperature within the leading edge of the wing?

1. Solar radiation
2. Bleed-air leakage
3. Malfunctioning modulating valve
4. Both 2 and 3 above

3-38. The fuselage bleed-air shutoff valves are normally open during deicing operation.

1. True
2. False

3-39. To perform the deicing leak test, the manifold pressure must reach what minimum psi reading?

1. 40
2. 55
3. 70
4. 85

3-40. What should be the maximum number of seconds required for the accept light to illuminate during the leak test?

1. 8
2. 12
3. 15
4. 20

Learning Objective: Identify rain-removal system components, functions, and operating features.

3-41. The A-6 rain-removal system uses bleed air from what stage of the engine compressor?

1. 12th
2. 13th
3. 14th
4. 15th

3-42. What shutoff valve controls the airflow from the rain-removal system to the windshield?

1. Nosewheel well bleed-air
2. Rain-removal pressure-regulator
3. Main engine bleed-air
4. Cabin bleed air

3-43. Upon loss of electrical power, the nosewheel well bleed-air shutoff valve will be in what position?

1. In the open position
2. In the closed position
3. In the last selected position
4. In the manual position

3-44. What type of power is used to operate the rain-removal pressure-regulator shutoff valve?

1. Hydraulic
2. Pneumatic
3. Electric
4. Manual

3-45. What rain-removal system component mixes cool air with hot bleed air?

1. Ejector
2. Plenum
3. Nozzle
4. Coupler

3-46. In what two positions may the nosewheel well bleed-air switch be placed?

1. ON and OFF
2. AUTO and ON
3. AUTO and OFF
4. MANUAL and OFF

3-47. When the windshield switch is placed in the AIR position, through what circuit breaker does the dc voltage flow?

1. Anti-ice
2. Air-conditioning
3. Rain-removal
4. Windshield air

3-48. What total number of nozzles are on the A-6 windshield?

1. 22
2. 24
3. 26
4. 28

Learning Objective: Identify anti-g system components, functions, and operating features.

3-49. Which of the following phases is most inclusive of the overall function of anti-g system?

1. Pilot fatigue relief
2. Blackout protection
3. Acceleration g-force indication
4. Flight exertion compensation

3-50. What is the source of air pressure required for the operation of an anti-g system?

1. The emergency survival kit cylinder
2. The air-conditioning ducting
3. The engine compressor bleed-air ducting
4. Either 2 or 3 above, depending on the type of aircraft

3-51. What is the exact air pressure to the g-suit when the control knob is set to LO and the aircraft pulls 3 g's?

1. 1.78 psi
2. 1.87 psi
3. 1.97 psi
4. 2.08 psi

3-52. In what location in an anti-g system is the filter unit installed?

1. In the inlet port of the anti-g valve
2. In the outlet port of the anti-g valve
3. In the supply line to the anti-g valve
4. Either 2 or 3 above, depending on the type of aircraft

3-53. If the required test equipment is available, dual range anti-g valves may be repaired by AIMDs; however, repair of single stage anti-g valves is not recommended.

1. True
2. False

3-54. Which of the following actions should you take after removing and replacing the g-filter?

1. Make a logbook entry
2. Check for air leaks
3. Check for free piston movement
4. Test the relief valve

3-55. While testing the dual range anti-g valve in the HI position, audible indications of piston, lower weight, upper weight, and pushbutton repositioning occur following a hard downward shake of the valve. This indicates that the valve

1. is operating properly
2. requires cleaning and lubrication
3. pushbutton requires repositioning and a security check
4. weights must be readjusted to their original positions

Learning Objective: Identify canopy seal system components, functions, and operating features.

3-56. What valve prevents the canopy seal pressure from becoming excessive during rapid altitude changes?

1. Dump
2. Relief
3. Outflow
4. Shutoff

3-57. Electrical failure of the canopy seal system will cause which of the following actions to occur?

1. The relief valve will close
2. The dump switch solenoid will energize
3. The solenoid valve will energize
4. The regulator valve will dump

3-58. When a pressurized-type aircraft is stowed without a canopy cover, the canopy seal should be inflated to protect the cabin area. This statement applies specifically to

1. aircraft stowed on the carrier's flight deck
2. a carrier-type aircraft whether at sea or landbased
3. all operational fighter and attack aircraft
4. an aircraft aboard a carrier

3-59. Refer to table 5-1 in your text. During a ground test on an electrically actuated canopy seal system you find that the seal will not inflate. If you determine that all controls pertinent to the proper operation of the seal have been activated, which of the following conditions could cause the trouble?

1. A ruptured seal
2. A defective canopy seal regulator or check valve
3. A defective power supply circuit to the seal regulator
4. Each of the above

Learning Objective: Identify onboard oxygen generating system components, functions, and operating features.

3-60. Which, if any, of the following is an advantage of the OBOGS as compared to LOX?

1. An OBOGS requires extensive depot-level maintenance
2. An OBOGS eliminates the need for daily servicing
3. An OBOGS requires special transportation and storage equipment
4. None of the above

3-61. Through which of the following components does the OBOGS receive engine bleed air?

1. Engine turbine
2. Heat exchanger
3. Cooling turbine
4. Ram-air outlet

3-62. Which, if any, of the following elements is retained in the molecular sieve beds as the airflow passes through them?

1. Oxygen
2. Nitrogen
3. Argon
4. None of the above

3-63. What component acts as a surge tank and an accumulator for the OBOGS?

1. Plenum
2. Reservoir
3. Heat exchanger
4. Oxygen monitor

Learning Objective: Identify missile cooling system components, functions, and operating features.

3-64. What type of coolant is used in the missile cooling system?

1. Freon
2. Hydraulic fluid
3. Dielectric fluid
4. Methyl alcohol

3-65. What component houses the coolant pump and the air-moisture-contaminant remover?

1. Right wing fillet
2. Starboard fairing
3. Port fairing
4. Left wing fillet

3-66. The missile coolant pump circulates the coolant at what prescribed rate?

1. 8 gallons per minute
2. 8 gallons per second
3. 18 gallons per second
4. 18 gallons per minute

3-67. When the missile cooling system is in the warm up mode, in what position are the (a) cold air and (b) hot air modulating valves?

1. (a) Open (b) open
2. (a) Open (b) closed
3. (a) Closed (b) closed
4. (a) Closed (b) open

3-68. What valve prevents the missile cooling system from being over pressurized during operation?

1. Pump relief
2. Missile relief
3. Missile bypass
4. Pump bypass

3-69. What material is used to cool the missile coolant pump?

1. Refrigerated air
2. Ram air
3. System coolant
4. Freon

3-70. In what units of measure is the pneumatic pressure indicator marked?

1. Degrees Fahrenheit
2. Pounds per square inch
3. Pounds per square foot
4. Degrees centigrade

3-71. Which of the following contaminants will the remover NOT filter from the coolant?

1. Air
2. Moisture
3. Foreign particles
4. Standing water

3-72. If the remover filter is clogged, what color button extends to serve as a warning?

1. White
2. Red
3. Yellow
4. Green

3-73. Which of the following coolants should NOT be used in the missile cooling system?

1. Flo-cool 108
2. Flo-cool 180
3. Coolanol 25
4. Coolanol 25-R

3-74. What is the mininum number of minutes that the coolant should be circulated by the aircraft pumps before a sample is taken?

1. Five
2. Six
3. Seven
4. Eight

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NRCC AVIATION STRUCTURAL MECHANIC E 1&C
NAVEDTRA 10312-D

NAME ____________________ ADDRESS ____________________
Last First Middle Street/Ship/Unit/Division, etc.

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City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ____________ DESIGNATOR ________ ASSIGNMENT NO. ________

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